HIGH-FREQUENCY FORECASTING MODELS OF NATIONAL ACCOUNT VARIABLES IN TRANSITION ECONOMIES (RUSSIA, ARMENIA, AND THE CZECH REPUBLIC)

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Economics
by
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Abstract

This study shows that despite the shortness of time-series and significant structural change the economies of three transition countries – Russia, Armenia, and the Czech Republic – have started to demonstrate regularities that can be used in some types of econometric forecasting. The high-frequency models developed here generate relatively accurate short-term forecasts of quarterly national account variables, overall 53 for the three countries, and ultimately real GDP. They can serve as a foundation for real-time short-term forecasting models and can provide initial conditions for medium-term or long-term structural forecasting models.

Government agencies and business analysts worldwide monitor high-frequency information that is released on a monthly and or even more frequent basis to estimate lower frequency data, such as quarterly national account data, before reports on these data are released. Such estimates are important, for example, in the preparation of government budgets. For example, the U.S. Treasury Department routinely uses high-frequency modeling to project GDP and tax receipts. The timeliness of these estimates may be critical near business-cycle peaks and troughs, since the government needs time to prepare counter-cyclical measures. The models that I have developed may help the governments of transition countries in economic policy decision-making.

The two main methodological features of the models – the forecasting of real GDP directly and through its elements and the method of principal components – allow for the incorporation of a large number of explanatory variables. The selected complex forecasting regressions satisfy a series of absolute and comparative forecast accuracy criteria, and this study shows that forecasting accuracy improves if the model takes into account signals from a large variety of indicators.

Chapter 1 describes the model methodology, forecast accuracy testing, and statistical problems. Chapter 2 provides a review of relevant literature. It focuses on the place of the model among forecasting approaches, compares the costs and benefits of the
methodology applied here with those of other methods, and discusses practical applications. Chapter 3 describes economic growth trends in the three countries and the indicators that are generally considered growth determinants. It provides an overview of the selection of forecasting regressions and the satisfaction of forecast accuracy criteria.
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Introduction

This study contends that macroeconomic time series for Russia, Armenia, and the Czech Republic – three transition countries that significantly differ from each other in size, geographic location, degree of market transformation, level of income, economic policy, and many other major economic characteristics – have become long enough for some kinds of econometric research, and that their economies have started to demonstrate regularities that can be used in econometric forecasting.

To support this contention, I search for short-term regularities between quarterly national account variables and key monthly and quarterly macroeconomic indicators – regularities that have been observed in many developed countries and developing countries with market economic systems. I show how the identified regularities can be applied to short-term forecasting and to the identification of factors driving the Russian, Armenian, and Czech economies.

Government agencies and business analysts worldwide monitor high-frequency information that is released on a monthly, and sometimes weekly or even daily basis, to estimate, using formal or informal methods, lower frequency data, such as quarterly national account data, before reports on these data are released. Such estimates are important, for example, in the preparation of government budgets. For example, the U.S. Treasury Department routinely uses high-frequency modeling to project GDP and tax receipts. The timeliness of these estimates may be critical near business-cycle peaks and troughs, since the government needs time to prepare counter-cyclical measures.

It has been 13 years since the beginning of fundamental market reform in most of the former Soviet Union and about 15 years in most of Eastern Europe. Whether such transition countries as Russia and Armenia have become fully functioning market economies is debatable. However, it is clear that the current economic system in these countries is vastly different from the centrally planned system that existed there until the late 1980s-early 1990s. Therefore, economic information from the pre-reform period has
become largely irrelevant to formal macroeconomic analysis. Moreover, it is also evident that the current economic system differs significantly from the system in place during the early stages of the transition. Likewise, the statistical system has undergone major transformation. Since this transformation has continued for many years, economic data from the late 1980s and the early 1990s are usually not comparable with more recent data. Also, some important macroeconomic data that are collected now were not collected several years ago.

With the accumulation of consistent information over the past several years, demand for rigorous analysis and forecasting, including high-frequency forecasting, from the governments in transition countries has also been growing. At the same time, it has often been argued by academic and government researchers that because data in most of the former Soviet Union countries and in many countries of Eastern Europe are of poor quality, because macroeconomic time series are still very short, and because many transition countries are still undergoing dramatic structural changes, econometric macroeconomic forecasting remains unsuitable for these countries.

This dissertation shows that the national account variables in the three selected countries can be forecasted with significant accuracy. At the same time, the above-mentioned concerns are justified, and the forecasting of economic developments in transition countries represents a challenge for an econometrician. The existing datasets should be utilized, but serious data deficiencies should scale down expectations for forecast accuracy in transition countries. Although the relevant series contain the number of observations sufficient for the econometric methods applied in this study, these series are still very short compared to those in most developed countries. Both the selected economies and their statistical systems are rapidly evolving. Therefore, the results of this study should be considered suggestive and not definitive. The parameters of the discovered regularities may change significantly in the near future. By repetitive re-estimation and extrapolation one can observe how stable the regularities are and how they can be interpreted for macroeconomic decision-making. In a few years, many new observations of data will have been made, and the present groundwork should serve
forecasters well in building an improved structural system. Also, most economic developments are gradual enough that future models can build upon earlier accomplishments.

The dissertation is organized as follows. Chapter 1 describes the model methodology, forecast accuracy testing, and statistical problems. A central forecasted variable in this model is quarterly real GDP. It is forecasted directly and through its elements. This combination of GDP forecasting approaches reflects the combination of the GDP estimation approaches applied by statistical agencies. A key methodological approach in the forecasting of almost all of the national account variables in this study is the method of principal components. This method allows for a transformation of the original set of monthly indicators into a lower-dimension set of mutually independent principal components. In addition to principal components, the right-hand-side regression variables applied in this dissertation include, but are not limited to, “special” monthly indicators (the key variables that official statisticians use to produce preliminary estimates of the respective quarterly national account variables), structural break (crisis) dummy variables, and autoregressive and moving average terms, which are used to “whiten”, or randomize, the regression residuals. I call regressions that include these variables complex regressions as opposed to simple single-variable regressions.

Chapter 2 provides a review of relevant literature. It focuses on the place of the model developed in this dissertation among other approaches to macroeconomic forecasting, compares the costs and benefits of the methodology applied here with those of several other methods, and discusses practical applications. The approach adopted in this dissertation is within the framework suggested by Lawrence R. Klein, who has proposed several directions of model improvement that have potential to increase forecasting accuracy through the timely utilization of available data. In particular, this model serves as the foundation for real-time models that allow for the incorporation of monthly and even higher-frequency data as soon as such data are released. It is also designed to provide initial conditions for a medium-term or a long-term structural forecasting model.
Chapter 3 describes economic growth trends in the three countries and the indicators that are generally considered growth determinants. It provides an overview of the selection of forecasting regressions for 53 national account variables (22 for Russia, 14 for Armenia, and 17 for the Czech Republic). Each GDP component sub-section describes the size of the component relative to total GDP, its correlation with GDP, and its relationship to the corresponding "special" indicator, if applicable. This chapter describes the accuracy of the individual national account variable forecasts and the accuracy of the projected GDP aggregates according to the system of forecast accuracy testing proposed in Chapter 1. In particular, it compares the accuracy of the forecasts obtained from complex regressions with the accuracy of the forecasts generated by simple, single-variable regressions. Special attention is paid to the incorporation of crisis dummy variables into Russian and Czech regressions.
Chapter 1. Methodology

1.1. Model Variables and Data Transformation

*Quarterly real GDP* is a central variable that I forecast in this model. The forecasting of other national account components, although important, in this study primarily serves to improve the precision of real GDP forecasting.

Statistical agencies usually estimate total GDP through three methods: production, final expenditures, and income. Not all agencies use all three methods. Sometimes, a method may be used on an annual basis, but not on a quarterly basis. Also, a method may be applied only in nominal terms, but not in real terms.

The Russian Federal Service of State Statistics (Rosstat) estimates quarterly GDP using all three methods. However, the income-side components are available only in nominal terms. GDP estimated as the sum of the production-side components, which is also called GDP at market prices, is considered the main GDP estimate by Rosstat. Production-side GDP equals income-side GDP, since gross profit and mixed income, an income-side component, is estimated as the difference between income-side GDP and the sum of the rest of the income-side components. The sum of the expenditure-side components equals the sum of the production-side components less the statistical discrepancy, which is usually relatively small. From the first quarter of 1995 through the third quarter of 2004, the absolute value of the nominal discrepancy, on average, equaled 1.0% of the sum of the nominal production-side components. However, in several quarters, it exceeded 2.0%.

On the production side, Russian GDP is broken down into GDP at basic prices (total value-added) and net taxes on products and imports. GDP at basic prices is broken down

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1 This is fairly large. A two-percentage point difference between the two estimates may mean that the assessment of economic growth may vary depending on which estimate is used. For example, one may conclude that the Russian economy is performing on target if it grows at 7% and is under-performing if it grows at 5%.
into goods production value-added and services production value-added. Goods production value-added consists of value-added in industry, construction, agriculture, and other goods production. Services are divided into market services and non-market services. Market services are broken down into trade (retail trade, wholesale trade, and catering), transportation and communication, and other market services.

On the final expenditure side, GDP is broken down into final consumption, investment, and the foreign trade balance of goods and non-factor services. Consumption is comprised of household consumption, government consumption, and consumption by non-commercial organizations serving households. Investment is divided into gross fixed investment and change in inventories. The foreign trade balance is the difference between exports and imports.

On the income side, GDP consists of employees' compensation, including hidden, gross profit and gross mixed income, and net taxes on production and imports.

In Armenia, the National Statistical Service (NSS) estimates quarterly production-side and expenditure-side GDP components, but not income-side components. The discrepancy between the GDP figures estimated using the sums of the production-side components and the expenditure-side components is much higher in Armenia than in Russia. On average, from the first quarter of 1997 through the third quarter of 2004, the absolute value of the difference between nominal GDP at market prices and the sum of the expenditure-side components was 3.2% of GDP. In several quarters, it exceeded 5%.

The main difference between Armenia and Russia on the production side is that in Armenia non-market services valued-added is not estimated separately. The Armenian category “other services” contains two Russian categories “other market services” and “non-market services”. On the expenditure side, the NSS does not provide data in constant prices on the consumption of non-commercial organizations serving households, the share of which in nominal GDP is negligible – less than 0.5% of GDP. Also, real investment is not broken down into fixed investment and change in inventories, but the
The share of change in inventories in nominal GDP was also minuscule in 2002 and 2003 – about 0.5% of GDP. More importantly, the NSS does not estimate real exports and imports separately. It publishes only the real trade balance figures.

The Czech Statistical Office (CSO) publishes production-side, expenditure-side, and income-side series. The income-side series begin in 2000 and are too short for formal modeling. In nominal terms, there is no discrepancy between the expenditure-side and production-side total GDP estimates. In 1995 prices, the statistical discrepancy appears only starting with the first quarter of 1997. It gradually rises toward the end of the historical sample, exceeding 5% of GDP in two quarters of 2003 and 2004. The breakdown into expenditure-side components is the same as in Russia. The production-side breakdown is much more detailed than in Russia – the CSO publishes about 20 production-side series. However, in this model, several small sector variables are aggregated into the "other sectors" category. Since the CSO does not release monthly indicators for most of these variables, their forecasting on an individual basis would be difficult.

At the early stages of econometric macroeconomic forecasting, data were usually available on an annual basis (see Klein and Park, 1993). In the late 1950s and early 1960s, quarterly data, including national accounts, became widespread. At that time, "high-frequency" meant quarterly. With the further development of the methods of data collection, more and more monthly, and even higher-frequency data became available, and quarterly data became relatively low-frequency. However, in most countries, most of the national account variables are still estimated by statistical offices on a quarterly basis, and comprehensive national account datasets are normally released after all of the monthly data are published.

There are countries that publish some national account data on a monthly basis, but the quality of such data are often suspect since monthly information is usually not sufficient for national account estimation. The U.S. Department of Commerce refused to provide the Chairman of the Board of the Federal Reserve System with monthly GDP figures.
because it could not guarantee quality (Klein and Park, 1993). Russia published monthly GDP data after the collapse of the Soviet Union, but stopped this practice in 1998. Canada provides monthly GDP, but not its components that frequently.

The methodology applied in this dissertation to the forecasting of GDP and its components in the three transition countries generally follows the principles developed for high-frequency national account forecasting by Lawrence R. Klein (see Chapter 2 for the literature review).

In this study, final real GDP forecast figures are calculated as the simple average of real GDP figures obtained through the following four approaches:

1. real GDP forecasted directly;
2. real GDP forecasted as the sum of real expenditure-sum components;
3. real GDP forecasted as the sum of real production-side components;
4. real GDP forecasted as the ratio of nominal GDP to the GDP deflator.

This combination of GDP forecasting approaches reflects the combination of the GDP estimation approaches applied by statistical agencies. Approach 4 requires additional explanation, as in the Russian case it includes extra steps. I want to incorporate information on the income-side of national accounts into the model, but Rosstat provides only nominal income-side GDP components. Therefore, at the first step, I forecast nominal income-side components and combine these forecasts to obtain the first estimate of total nominal GDP. At the second step, I forecast total nominal GDP directly. This is similar to the direct way of obtaining real GDP forecasts (Approach 1). At the third step, the final nominal GDP figure is calculated as the simple average of nominal GDP forecasted at steps 1 and 2. At the fourth step, I forecast the GDP deflator. Finally, the forecasted value of nominal GDP obtained at step 3 is divided by the forecasted value of the deflator obtained at step 4 to calculate the Approach 4 real GDP estimate.

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2 GDP at market prices is used for direct GDP forecasting.
A key methodological approach in forecasting almost all of the national account variables in this study is the method of principal components (PCs), which was introduced by Karl Pearson in 1901 and has since been applied in many fields of scientific research, including psychology, biology, and economics. The method of principal components is a data transformation technique (Judge, 1985). Other techniques of data transformation used in this research include logarithmic transformation and first differencing. It can also be said that this method transforms the original indicators into a canonical form.

Suppose we have a set of $n$ indicators. This set can be transformed into an $n$-dimensional set of principal components. The principal components are linear combinations of all of the indicators in the original indicator set. The weight with which the indicator $i$ enters the linear function for the principal component $j$ is the element of the Eigenvector $j$ that corresponds to the indicator $i$.

Principal components are not correlated with each other (in other words, they are mutually orthogonal). Thus, the method faces up to the problem of multicollinearity among original indicators. The variance of the principal components equals the overall variance of the original indicators, and each principal component accounts for a certain percentage of the variance of the original indicators. By definition, the first principal component (PC1) accounts for the highest percentage of the variance, the second principal component (PC2) accounts for the second highest percentage of the variance, etc. Some principal components explain only a minuscule percentage of the variance. Typically, principal components that explain a substantial portion of the variance are used in regressions, while the rest might be disregarded. In this study, I usually consider only the first $m$ principal components that jointly explain up to 85% of the variance. Thus, the application of principal components allows for such a reduction in the number of independent variables (and, consequently, an increase in the degrees of freedom) that retains the most valuable information about the original indicators.

The method of principal components is sensitive to the unit of measurement of the original indicators. To avoid the sensitivity problem I use the correlation matrix method
of the standardization of the original data. If the element \( k \) of the series \( i \) is \( x_{ik} \), then the corresponding standardized element is \( (x_{ik} - \bar{x}_i)/s_i \), where \( \bar{x}_i \) is the average of the series \( i \) and \( s_i \) is its standard deviation.

For each national account variable, I select a comprehensive set of monthly explanatory indicators, from which I extract the principal components. These monthly indicators represent the supply-side, the demand-side, and the market-clearing forces of the economy. I attempt to identify indicators that are significant for the forecasted national account variable. This significance may be verified statistically, through a regression of the national account indicator on the explanatory variable in question and correlation coefficients, or indicator selection may be judgmental. Judgmental does not mean arbitrary. For example, since the world oil price and the ruble/U.S. dollar exchange rate are generally considered to be key factors behind Russian economic growth (see Section 3.1.1 for the discussion of economic growth factors in Russia), I include these two indicators in the set of monthly indicators for every real national account variable, regardless of the magnitude of the correlation coefficients between these two indicators, on the one hand, and the national account variable, on the other hand. The inclusion of an indicator into a set from which principal components are extracted or its removal from this set is ultimately based on whether this helps improve the quality of the respective national account regressions, including the properties of the residuals, the goodness of fit, and the accuracy of out-of-sample forecasts.

Let us consider the set of indicators for Russian real GDP (see Appendices for the lists of selected indicators for each national account variable; Appendices also provide information on the regressions of GDP on individual indicators). Many of these indicators are the same as or similar to the indicators used in principal component models or coincident and leading indicator models for other countries.

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3 The monthly dataset used in this study consists of hundreds of series, of which several dozen have been selected for forecasting equations.
As I mentioned, world oil prices and the real ruble/dollar exchange rate are included in the GDP indicator set as perceived key growth factors. Several of the other indicators represent key economic sectors and play a major role in determining individual GDP components. Industry is a special case. The U.S. Conference Board uses the industrial production index as one of the four coincident indicators and stresses that the importance of industrial production in capturing GDP fluctuations is greater than what can be explained based on the sector's size. Industrial production does appear to be an important coincident indicator for Russian GDP. The correlation coefficient between the quarterly GDP index and the industrial production index, which was just marginally different from the industrial value-added index, was 0.92. Only to some extent can this high correlation be explained by the size of the industrial sector, which in 2003 accounted for 24.0% of GDP and 26.7% of overall value-added produced by the Russian economy. The correlation coefficient between the GDP index and the household consumption index was 0.67, much smaller, though the share of household consumption in GDP was 49.7% in 2003, more than twice the size of industrial value-added. Among the reasons why industry is so important in Russia is the fact that industrial production includes production in the energy sector, which is generally considered the backbone of the Russian economy.

At the initial stages of this research, real industrial production was included in the set of monthly indicators from which the principal components are extracted, in addition to several major industrial products measured in physical units. However, later it was decided to drop real industrial production in order to avoid double counting. Currently, in the set of indicators for real GDP, industrial production is represented by seven commodities, the selection of which has been somewhat biased toward the energy sector. The use of industrial production in this disaggregated (and incomplete) form is an attempt to diversify the monthly indicators by introducing indicators in physical units, for which industry is the best choice given physical unit data availability. This follows the selection of indicators by Klein and Ozmucur (2003), who stressed the importance of the diversification of indicators for the Chinese principal component model. The importance of industry for the Russian economy and data availability also justify the disproportionate
share of industrial indicators in the total set of industrial indicators. The replacement of the seven industrial commodities with real industrial production worsens the out-of-sample forecast of GDP.

There is another indicator in the indicator set for GDP that is somewhat related to industry. This is the ratio of defense budget spending to overall consolidated government budget spending, which is introduced as a proxy for the military industrial sector. Although it is much less important in modern-day Russia than it was in the Soviet Union, the defense sector still plays a major role and is the only sector that is both not closely related to raw materials and internationally competitive (possibly thanks to government support). I use the ratio of defense spending to total budget spending because defense spending in real terms is not available.

Construction is another sector that is highly correlated with GDP in Russia. The correlation coefficient between the quarterly GDP index and the construction index is 0.88, only slightly below the correlation coefficient between the GDP and industrial production indices, while the share of construction in GDP is about three and a half times smaller than the share of industrial production – in 2003, the former stood at 6.5% of GDP. In addition to industrial and construction indicators, I use three more indicators related to major production sectors (see the description of the production-side GDP components above). These are real agricultural production, real retail sales, and freight-transportation in ton-kilometers. The Conference Board uses manufacturing and trade sales (wholesale and retail) as a coincident indicator, but Rosstat does not publish high-frequency data related to either manufacturing or wholesale sales. Moreover, until 2004, Rosstat did not disaggregate industrial data into mining, manufacturing, and utilities, and, therefore, did not publish any manufacturing data. Thus, of Russian high-frequency indicators, the retail sales indicator is the closest to manufacturing and trade sales applied by the Conference Board.

In addition to being linked to sectoral value-added, some of the sectoral monthly indicators are closely associated with expenditure-side national account components.
Retail sales are closely linked to household spending, the largest expenditure-side GDP component. Construction is associated with fixed investment. In fact, it represents a portion of it. Fixed investment in Russia is described by two variables: one is an expenditure-side GDP component and the other is a monthly indicator. To avoid double-counting I include either construction or fixed investment calculated on the basis of the “monthly” methodology (but not both) in the sets of monthly indicators from which principal components are extracted. For the real GDP indicator set, I choose construction because of the remarkably high correlation between its growth and GDP growth.

Except for the above-mentioned defense spending ratio, government consumption is not represented in the set of indicators for GDP. The reason is that Russia does not provide high-frequency data related to real government activity. In the indicator sets for some other national account components, I use the ratio of consolidated government budget expenditures to revenues as an indicator characterizing the tightness of fiscal policy. However, this indicator is not included in the GDP indicator set because it does not improve GDP out-of-sample forecasts. The ratio of merchandise exports to merchandise imports is used as a proxy for the foreign trade balance, another major GDP component. Change in inventories, the most volatile GDP component, is represented by inventories in retail trade. Rosstat does not release any other high-frequency information on inventories.

In the set of indicators for GDP, real average wage serves as a proxy for employees’ compensation – the largest income-side GDP component. The U.S. Conference Board uses real personal income less transfer as a leading indicator. Rosstat does estimate per capita personal income on a monthly basis, and it could be used as one of the indicators in the GDP data set. However, the replacement of wages with income worsens the out-of-sample GDP forecasts. Both wages and income are seriously flawed indicators in Russian statistics. It is possible that the former is less flawed than the latter. Another labor indicator in the GDP set is employment. The Conference Board uses the number of employees on nonagricultural payrolls as a coincident indicator. Rather surprisingly,

4 There is a discrepancy between the quarterly national account fixed investment indices and the quarterly fixed investment indices calculated using the “monthly” methodology.
Rosstat publishes total monthly employment figures, which should be more difficult to estimate than payroll employment.

Real M2 is the only indicator on the list of GDP indicators that is closely related to economic policy. The Conference Board considers it a leading indicator, arguing that when nominal money growth falls behind inflation, real bank lending may decline, hurting the economy. In Russia, real M2 appears to be a coincident indicator. The real GDP index is strongly and positively correlated with the contemporaneous real M2 index. If M2 is taken with a lag, the correlation with GDP declines and then becomes negative.

Finally, the GDP indicator set includes the ratio of consumer prices to industrial producer prices, which is an important market-clearing indicator, along with wages.

For other national account variables, the sets of monthly indicators will be different. For example, for trade value-added there is more emphasis on consumer goods production. Obviously, the set of indicators for the GDP deflator is dominated by price indicators. For many national account variables, most of the monthly indicators may be the same as for GDP as a whole for two reasons. First, there may be very few monthly indicators that are directly linked to a particular GDP element. Second, in Russia, most national account variables are significantly correlated with total GDP.

Principal components are not the only explanatory variables that are used in this model, and, frequently, they are not the most important variables. Many national account variables represent economic phenomena similar to those that are represented by some monthly explanatory variables. For example, in the Russian and Armenian models, for agricultural value-added and household consumption these explanatory variables are, respectively, agricultural production and consumer spending on goods and services. Such monthly indicators are key variables that statisticians use to calculate quarterly national account variables. In the high-frequency national account modeling framework described by Klein and Park (1993), the equations that link these monthly indicators with the respective quarterly national account variables are called “bridge” equations, as they
serve as bridges between the forecasts of monthly indicators and quarterly national account forecasts.

I call such indicators “special” indicators. They play the key role in the “bridge” equations used in this study. However, unlike in the Klein-Park approach, in addition to “special” indicators, in the “bridge” equations, I also use principal components extracted from other monthly indicators. “Special” indicators are not usually included in the set of indicators from which principal components are extracted. Instead, they are used as separate independent variables. In Chapter 3, in the discussion of the forecasting of individual national account variables, I describe how close the indices of a national account variable are to the indices of the corresponding “special” indicator.

By analyzing revisions to Russian data, one notices that sometimes the absolute value of the difference between the indices of a national account variable and the indices of the respective “special” indicator grows after a revision of national accounts. For example, before the February 2005 national account revision, the difference between the index of agricultural value-added and the index of agricultural production was below 0.25 percentage point for three quarters in 2003 and equaled 2.4 percentage points in one quarter. After the revision, the absolute value of the difference became much higher, ranging from 3.1 to 4.7 percentage points. Another similar increase in such a discrepancy was observed in the 2002 construction figures, though on a much smaller scale. It is difficult to assess whether such increases in discrepancies occurred because Rosstat has delayed the revision (or the publication of the revision results) of the “special” indicator series or because initially the national account variables were estimated primarily on the basis of “special” indicators, but later were adjusted when more information from different sources became available. In any case, this supports the inclusion of principal components in “bridge” equations in addition to “special” indicators.

In a regression for which I can identify a "special" indicator, principal components may play only a secondary role compared to the "special" indicator, but they are important in refining the forecast. However, for some national account variables, the logical candidate
for the role of special indicator may not be sufficiently correlated with the respective national account variable and may not be able to play the key role in its forecasting. Such an indicator may be, instead, included in the set of monthly indicators, from which principal components are extracted, or even completely disregarded. For some national account variables, for example, for non-market services value-added, the "special" indicator does not exist. In this case, the role of principal components becomes crucial. Of course, there is no “special” indicator for total GDP.

Some of the explanatory variables that are used here, such as balance of payments and budget indicators in Armenia, are available only on a quarterly basis. They are not combined with monthly indicators selected for the extraction of the principal components. This study is not intended to identify a comprehensive system of links between the balance of payments and national account variables. Nevertheless, since the former variables are generally considered highly significant for the Armenian economy, I make an effort to incorporate them into the model. Such quarterly indicators are used as separate independent variables, in addition to the special indicators.

Klein and Park (1993) described the ways of introducing other country variables into high-frequency models, for example, by including these variables into equations for forecasting “special” indicators. In this study, I attempt to link two individual country high-frequency models, the Armenian model to the Russian model, by applying two approaches. First, Russian real GDP is entered directly in regressions that are used to forecast Armenian “special” indicators, principal components, and national account variables. Second, Russian real industrial production is included in the set of monthly indicators from which principal components are extracted to forecast Armenian GDP.

"Special" indicators and other independent quarterly indicators may be highly correlated with each other and the principal components. For example, I found that in Armenia, a "special" indicator is almost always highly correlated with PC1. If the absolute value of the correlation coefficient between two explanatory variables exceeds 0.65, only one of the variables is used in the regression.
A forecasting model should exploit identified trends and patterns in the residuals, including seasonal, to increase its predictive power. The residuals in a regression selected for forecasting should be random. This is another way of saying that the forecasters should try to build equations that lead to a separation of “signal” from “noise”.

In time series, residuals often depend on previous residuals; i.e., they may follow an autoregressive (AR) process. The presence of serial correlation in residuals results in the loss of efficiency. Standard error estimates will be smaller than the true standard errors (see Pindyck and Rubinfeld, 1991). Many time-series models also possess moving average (MA) qualities; i.e., the forecasted variable may depend on the weighted average of random disturbances going back a number of periods. To exploit the autoregressive and moving average processes, AR and MA terms of various orders are incorporated into regressions in this study.

Macroeconomic data are usually highly seasonal, especially in Armenia. Sophisticated statistical methods of seasonal adjustment are not applicable to the countries studied here, since such methods should be based upon much longer time-series than those that are currently available. In the Russian and Czech models, the year-over-year indices were used to adjust the data for seasonality. The Armenian historical sample is shorter than the Russian and Czech samples. In the Armenian case, seasonal dummy variables (for example, DUMMY1 = 1 in the first quarter, = 0 otherwise) were used to avoid losing a year of observations because of applying the year-over-year indices. The seasonal effect was also reduced by the introduction of lagged dependent variables in some equations.

On a rare occasion, the difference between the actual and the fitted value of the dependent variable remains unusually high for a certain quarter regardless of the regression specification. Formally, this is the case when the Jarque-Bera statistic shows that the residuals are not normally distributed. In such a case, I consider that data point an outlier and introduce a dummy variable that equals 1 in that quarter and 0 otherwise. The

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5 For each dummy one degree of freedom is lost.
The problem of outliers is more common in the forecasting of principal components through ARMA regressions. National account regressions use a large variety of right-hand-side variables, not only ARMA terms, and usually provide a good fit for national account series even in peaks and troughs.

When justified, I introduce dummy variables reflecting the structural breaks that occurred in Russia and the Czech Republic as a result of the August 1998 crisis and the May 1997 crisis, respectively (see Section 1.3).

### 1.2. Regression Estimation and Forecast Accuracy Testing

To summarize the description of the model variables in the previous section, a national account variable regression generally includes the following right-hand-side variables: the “special” explanatory indicator, other quarterly variables (such as balance of payment variables and Russian GDP in the Armenian case), principal components, dummy variables (crisis dummy variables in the Russian and Czech cases), seasonal dummy variables in the Armenian case, and dummies for outlier observations), lagged dependent variables, and ARMA terms. The coefficient of a right-hand side variable is considered statistically insignificant if the absolute value of the respective $t$-statistic equals less than one. Sometimes, the coefficients of variables that are expected to be important, such as principal components that account for a substantial portion of the variance in the original monthly indicators, are found insignificant. Because of the shortness of time series, variables with insignificant coefficients are not used in forecasting in this model. However, as economic conditions change, the coefficients of such variables may become significant and may be used in future models.

To ensure that the regression is statistically sound, I conduct several residual tests, including the Breusch-Godfrey Lagrange multiplier (LM) test, the ARCH test, the White heteroskedasticity test, and the normality test. The Durbin-Watson (DW) test statistic is usually ignored. The LM test for serial correlation is preferred to the DW test for two main reasons: (1) the LM test can be applied for any specified order of serial correlation.
in the residuals, while the DW statistic shows only whether first-order serial correlation is present, and (2) the LM test can be used when lagged dependent variables are included in a regression, while the DW statistic is invalid in this case. In regressions studied in this dissertation, serial correlation of orders higher than first is, in fact, frequently encountered, and lagged dependent variables are regularly included. Therefore, the use of the LM test is clearly justified. If the residual test results are found not satisfactory, I experiment with different regression specifications, for example, I include variables with different lags or different ARMA terms, or try another set of indicators from which the principal components are extracted.

If the residual properties are satisfied, the goodness of fit, measured by adjusted R-squared, becomes a criterion in the selection of a regression specification. There is no general rule saying what level of R-squared should be acceptable. I set the minimum acceptable level of adjusted R-squared for Russia and the Czech Republic at 0.75. In the Armenian model, for which I do not impose any restrictions on the presence of contemporaneous independent variables and in which seasonal adjustment variables account for a large portion of the variation in the national account variables, the minimum adjusted R-squared coefficient is set much higher, at 0.95.

The next, and the most important, step is testing for the accuracy of out-of-sample forecasting provided by a regression with satisfactory residual properties and a high adjusted R-squared. Normally, the forecasting horizon of this type of model is up to half a year, although its extension for up to a year may also be feasible. This is an empirical observation, based on the experience of high frequency forecasting in the United States and other countries (Klein, 2000). Longer-term forecasting should be a based on a structural model, for which our high-frequency model may serve as the foundation (see Chapter 2). I establish several rules for testing forecast accuracy.

Three methods of out-of-sample forecasting are applied here. The first method is current-quarter forecasting. In this case, the out-of-sample values of all the independent variables, including those that are contemporaneous with the forecasted national account variable,
are official values. In fact, initially, I attempt to use only contemporaneous principal components and “special” indicators. By doing this, I can still obtain econometric estimates of national account variables several weeks before the national account data are officially released. When regressions that use only contemporaneous explanatory variables do not appear to provide sufficient explanatory power, I also use lagged “special” indicators and lagged principal components in addition to contemporaneous independent variables. For this type of out-of-sample forecasting, the historical sample is reduced by two quarters, and the dependent variable is forecasted using the dynamic approach; i.e., previously forecasted values of the lagged dependent variables and residuals are used to calculate the forecast of the current values.

The second and the third methods assume one-quarter-ahead forecasting, which allows for obtaining the forecasts of national account variables for quarter $t$ as soon as the complete set of explanatory indicators for quarter $t-1$ becomes available. The second method tests the out-of-sample forecast accuracy of the same regression as does the first, current-quarter, method. Only in this case, contemporaneous independent variables (principal components and "special” indicators) are themselves forecasted for the out-of-sample quarter. To forecast them, I apply ARMA regressions with lagged dependent variables and dummy variables. In the Armenian model, lagged quarterly balance of payments variables and Russian GDP are also used.

The third method is applied only in the Russian model, although nothing prevents it from being applied to other countries. In this case, I use regression specifications that include only lagged independent variables.

In the first and the third cases, the forecasting of national account variables is conducted in one step, since official data for all of the used explanatory indicators are available. In the second case, when the contemporaneous explanatory indicators that are used in the national account regression have to be projected, the national account variable is forecasted in two steps.
The out-of-sample forecasts of the national account variables are assessed according to the following criteria. First, in the first type of forecasting (current-quarter), when a “special” indicator is available, the difference between the forecasted index of a national account variable and the official index of this variable (the model forecast margin of error) is compared with the difference between the official index of the corresponding “special” indicator and the official index of the national account variable. I expect the model forecast margin of error to be smaller than the latter difference. Otherwise, the official “special” indicator index should be used directly, without any econometric procedures, to estimate the national account variable index.

Second, the margin of error of the forecast provided by my model is compared to the margins of error of the forecasts obtained through several single-variable regressions (with lagged dependent variables and ARMA terms). If a “simple”, single-variable model provides a smaller forecast margin of error (and also satisfies the requirements related to residuals and to the goodness of fit described above) than the more complex model, the former can be used for the forecasting of the national account variable. If a “special” indicator is available, it is the first logical candidate for the independent variable in a single-variable regression. Independent variables in other single-variable regressions may be indicators that are considered important for the economy (such as world oil prices in the Russian case or private transfers from abroad in the Armenian case).

The third out-of-sample forecast accuracy criterion is purely judgmental. A national account variable may not have a “special” indicator. Also, the estimates of the index of the national account variable that equal the official index of the “special” indicator and the forecasts obtained through single-variable regressions may be too far from the official national account variable index to be used as benchmarks in forecast accuracy criteria. Therefore, I need to establish criteria for out-of-sample forecast accuracy that can be applied regardless of the official values of “special” indicators and single-variable regressions. As with adjusted R-squared, there is no general rule saying what accuracy should be sufficient. I will call a forecast of an index very accurate if its margin of error is below one half of a percentage point, accurate if the margin of error is between 0.5 and
1.5 percentage points, and *border-line accurate* if the margin of error is between 1.5 and 2 percentage points.

The fourth method of forecast accuracy testing is checking whether in the out-of-sample period the official value of the dependent variable is located within a certain confidence interval estimated for the reduced-sample forecast. In this model, the confidence interval is a +/- one standard error interval.

### 1.3. Structural Break Testing

During the period under consideration, two of the three countries studied here – Russia and the Czech Republic – experienced events that are characterized as crises. In August 1998, Russia announced that it would no longer support the ruble and effectively defaulted on its ruble-denominated sovereign debt. The ruble collapsed. At the end of September 1998, the ruble/dollar exchange rate stood at 16.1, a sharp depreciation from the rate of 6.2 at the end of July. These events were accompanied by banking, production, and political crises. In the third and the fourth quarters of 1998, GDP contracted, respectively, 8.8% and 9.1% year-over-year, by far the sharpest quarterly declines in 1996-2004, the period for which consistent quarterly GDP growth rates are available. Although inflation accelerated, the fall of the nominal ruble was so significant that in real terms the ruble lost almost half of its value by the end of December 1998. In the first quarter of 1999, Russian GDP contracted again, but since then it has been growing uninterruptedly. This contrasts favorably with the pre-crisis period: of the ten pre-crisis quarters, GDP rose only in two. The post-crisis expansion is generally believed to have been stimulated by the rise in world oil prices and the cheap ruble, as the Russian Central Bank adopted the policy of slowing the ruble’s real appreciation, a reversal of the pre-crisis policy of supporting the ruble (see Chapter 1.3 for a discussion of the factors of economic growth in Russia).

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6 Since this study focuses on real variables, the word “real” will usually be omitted.
The 1997 crisis in the Czech Republic was substantially less dramatic. In April 1997, the government introduced fiscal austerity measures and promised to implement a series of structural reforms. This, however, did not stop the downward pressure on the Czech koruna, and in May, the Czech Republic abolished a currency band regime. This resulted in an immediate depreciation of the koruna by about 10% against the U.S. dollar. Also in May, the government announced another austerity and structural reform package. After increasing 4.2% in 1996, Czech GDP started to contract in the second quarter of 1997. The economic contraction continued through the fourth quarter of 1998. While it lasted longer than in Russia after the 1998 crisis, it was not as steep. The most substantial quarterly GDP decline of 2.2% was posted in the third quarter of 1997. The Czech economy expanded uninterruptedly from the first quarter of 1999 through the last quarter of 2004.

It is likely that the drastic change in the exchange rate regime and changes in the financial system that occurred during and as a result of the crisis led to substantial changes in the patterns of interaction among the variables of this model. These changes should be exploited in forecasting. It is also possible that the pre-crisis data are useless for forecasting, at least for some of the national account variables. Regarding how to treat the pre-crisis and post-crisis periods, I have three choices:

1. to treat the pre-crisis and post-crisis periods without any distinction;
2. to introduce dummy variables reflecting the breaking down of the sample into the two periods;
3. to drop the pre-crisis period from the sample.

To make a decision on the treatment of the crisis, the following steps are taken for the Russian model.

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7 The model developed by the Center for Macroeconomic Analysis and Short-Term Forecasting in cooperation with other Russian think-tanks and Global Insight is based only on the post-crisis sample (see Chapter 2).
First, I carry out the Chow breakpoint test. This test assumes the partitioning of the historical sample into subsamples that represent structurally different periods. In this model, the first subsample includes observations from the second quarter of 1996 through the third quarter of 1998, and the second subsample includes observations from the fourth quarter of 1998 through the third quarter of 2004. The test shows whether there is a substantial difference in the regressions estimated for each subsample. The problem with the Chow breakpoint test is that it cannot be conducted when the number of observations in at least one of the subsamples is less than the number of estimated coefficients. This, in fact, is the case in many of the Russian national account regressions, in particular, when they include lagged variables and/or high-order AR terms, since the pre-crisis period includes only ten observations. In such a case, to carry out the Chow test, some of the right-hand-side variables may be omitted. However, the validity of the test may be questionable. The omitted variables may be so important that without them the regression may become essentially different.

Second, I estimate an equation repeatedly starting with the sample that includes only the first $k$ observations, where $k$ is the number of estimated coefficients, and then use ever-larger subsets of the sample. This allows for observing how stable each coefficient was and whether it changed significantly at the suspected breakpoint. The main problem with this test is the same as with the Chow breakpoint test – the pre-crisis sample may be too short.

Third, I introduce intercept and slope dummy variables taking into account the break (DUMMY=0 for the first subsample and DUMMY=1 for the second subsample) and determine whether the dummy variable coefficients are significant and whether their introduction improves adjusted R-squared and out-of-sample forecasts. When the number of explanatory variables in a regression is high, the shortness of the time series may prevent the introduction of all possible intercept and slope dummy variables simultaneously. In this case, various sets of dummy variables are tested. The tracing of coefficient changes conducted in the previous step may help in the selection of dummy variables.
Finally, the out-of-sample forecasts based on regressions with and without crisis dummy variables estimated for the sample that includes both the pre-crisis and post-crisis subsamples are compared with the out-of-sample forecasts obtained with regressions estimated only for the post-crisis sample. Thus, all the three options of the treatment of the pre-crisis and post-crisis period are evaluated. The regression that provides the best out-of-sample forecast is selected as the final forecasting regression for the considered national account variable, provided that the partial derivatives of these variables with respect to the explanatory indicators have reasonable signs (see Section 1.4). The pre-crisis period may be dropped from regressions selected to forecast some variables and included in regressions selected for other variables.

Since the Czech pre-crisis sample is even shorter than the Russian pre-crisis sample, the first two steps were skipped in the Czech case.

**1.4. Impact of Monthly Indicators on a National Account Variable**

The model allows for the calculation of the net contribution (partial derivative) of the individual monthly indicator to the behavior of a national account variable through the estimated principal component coefficients and the Eigenvectors. The signs of partial derivatives may indicate whether the selected regression correctly describes the economic process that I attempt to forecast. For example, one should expect that an increase in the production of a commodity (other variables held constant) should lead to an increase in GDP; i.e., the sign of the partial derivative of GDP with respect to the production of this commodity should be positive. If the signs of a substantial number of partial derivatives appear counterintuitive, the set of monthly indicators from which the principal components are extracted and/or the regression specification may need to be changed.

The partial derivatives provided in this study should be interpreted with caution, especially when other variables in addition to principal components are also included in the regression.
First, the partial derivative shows the impact of a monthly indicator on the national account variable only in the current quarter. To calculate a longer-term effect would require a different technique using longer-term changes in the indicator.

Second, the partial derivative shows the impact of a monthly indicator when all other indicators from the set used in the extraction of the principal components remain unchanged. It may mean, for example, that the impact of the ruble’s depreciation on the national account variable cannot move through merchandise exports or imports when they are also included in the set of indicators from which the principal components are extracted.

Third, as mentioned before, some principal components, especially PC1, may be significantly correlated with the “special” indicator. In that case, either the “special” indicator or the principal component has to be omitted. The omission of a principal component explaining a large portion of the variance in the original indicators may result in the distortion of the partial derivatives and, possibly, in their seemingly counterintuitive signs.

The linkage between the explanatory monthly indicators and a national account variable can be used in the calculation of the short-term impact of selected exogenous indicators on this national account variable. For example, economic growth in Russia is generally thought to have a strong impact on Armenian economic performance. Our model allows us to trace this impact. Since Russian GDP figures are provided quarterly, I use Russian industrial production, which is released monthly, as a proxy for Russian economic growth and include it in the regression for Armenian GDP. To estimate this impact I run a regression of each of the other indicators from the set of monthly indicators selected for Armenian GDP on Russian industrial production (with ARMA terms and lagged dependent variables). If, for a certain indicator the coefficient for Russian industrial production is statistically insignificant, it is assumed that Russian industrial production has no effect on the dependent variable.
The impact of Russian industrial production on Armenian GDP through a particular monthly indicator combines two impacts: the impact of Russian industrial production on the monthly indicator (reflected in the elasticity of the indicator with respect to Russian industrial production) and the impact of the monthly indicator on Armenian GDP. The impact assumes that all other indicators remain unchanged (ceteris paribus). Since Russian industrial production is also included in the set of monthly indicators, its influence on Armenian GDP can be indirect (through the other monthly indicators) and direct (mutatis mutandis, i.e., through the channels not reflected by the other monthly indicators).

If a certain indicator (such as a quarterly balance of payments indicator) is not included in the set of indicators from which I extract the principal components, then its impact on Armenian GDP cannot be fully separated from the impact of other indicators.

1.5. Statistics

Time series in transition economies are short, and are often justifiably considered inconsistent and of poor quality, especially in less developed countries. Nevertheless, despite serious shortcomings, even in some relatively poor countries, such as Armenia, statistical offices provide reasonably good sets of macroeconomic series that can be used for econometric modeling purposes. These datasets are comprehensive, covering key aspects of the economy, such as national accounts, production, sales, the government budget, foreign trade, and prices. They include time series with several years of monthly and quarterly data without missing observations. The existence of such datasets is not fully recognized, appreciated, or taken advantage of by local and Western economists. At

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8 Some policy or other economic changes may not be meaningful by themselves, as is required in the ceteris paribus conditions.

9 According to a World Bank study, the quality of statistics in transition countries has a strong positive correlation with per capita GDP (Belkindas, Dinc, Ivanova, 1999).
the same time, while these datasets should be exploited, serious data deficiencies should scale down expectations for forecast accuracy in transition countries.

Time series in transition economies are short for two main reasons. First, some data were not collected at all or were poorly collected before the transition and/or in the first years of the transition. Second, statistical agencies have themselves been in transition. Recent statistical methodological changes might have been so significant that they made portions of a time series incompatible with each other, while the statistical agencies do not have the desire or resources to adjust the earlier portion of the time series to ensure its comparability with the more recent portion. Even if relatively long time-series with methodologically comparable observations are available, they may not be applicable in formal modeling because of structural breaks caused by changes in the whole economic framework when countries went into transition.

Both of these reasons apply to transition countries’ national account variables, the forecasting of which is the focus of this study. In most transition countries of Eastern Europe and the FSU, comparable quarterly national account series begin in the mid-1990s; i.e., few countries have more than ten years of these data.

One of the most fundamental differences between the Soviet and Western statistical systems was the way they measured aggregate economic activity. Instead of the system of national accounts (SNA) applied in the West (see, for example, U.S. Department of Commerce 1985), the core of the Soviet statistical system was the concept of net material product (NMP). The main distinction was ideological. According to Marxist theory, the economy is divided into the productive and non-productive spheres. The productive sphere contains branches that produce material goods as well as services that have a direct impact on goods production or represent a continuation of goods production activity. The non-productive sphere includes services that are not directly or closely related to goods production. Marxist economists claim that value is created only in the productive sphere. Therefore, NMP, the key indicator of aggregate economic activity measured by Soviet statistics, reflected only the output of the production sphere (Becker,
The SNA does not exclude services that the NMP methodology consider non-productive. While admitting problems with the SNA, Western scholars generally considered the Soviet material product system “logically questionable and incomplete” (Bergson, 1991, p.5).

The division of services into productive and non-productive represented a problem for Soviet economists and statisticians themselves, since it was not always clear to them how to define the close association of services with goods production. Freight transportation and communication serving production were generally considered elements of production services. By contrast, defense, law enforcement, education, medical care, entertainment, and passenger transportation were included in the non-productive sphere.

The NMP methodology was applied not only in the Soviet Union, but also in Eastern Europe. Although the methods that East European statistical agencies used had some distinctions from the Soviet methods, they were generally similar (see Bergson, 1991).

In addition to the conceptual flaws of the aggregate measures, the Soviet statistical system had measurement flaws within the narrowly defined productive sphere. Among the key problems, Bergson (1991) mentions those related to the quality of the basic production data, new products, and prices.

Under the Soviet economic system, enterprises’ management had an incentive to exaggerate production figures, since the managers’ performance was often evaluated on the basis of the fulfillment of production plans. Åslund (1990) claims that over-reporting was close to 5% of GDP. Bergson (1991), while admitting that this deception was widespread, argues, nevertheless, that its impact on the main output aggregates was, possibly, not substantial, because of government control. Offsetting the tendency to exaggerate production was also the managers’ concern that higher reported production would lead to higher targets set by the planning authorities in the future.
Accounting for quality changes in output measures is a difficulty encountered by all statistical systems. Under the centrally planned system with government-controlled prices, it was aggravated by the fact that the introduction of a new product was often the only way to obtain government permission for a price increase. Therefore, enterprises introduced reportedly new products with little actual quality improvement, but with significantly higher prices. In general, prices, artificially fixed by the state, did not reflect the market value of goods and services. Since the production structure was not customer-oriented, the Soviet economy produced large quantities of low quality or simply non-needed goods.

Perestroika brought changes not only to the political and economic system, but also to the measurement of economic activity in the Soviet Union, its republics, and Eastern Europe. The Soviet State Statistical Committee (Goskomstat) started to measure gross national product, the first estimate of which was published for 1988, in addition to NMP. Armenia also started to develop its national account statistics in the late 1980s, when it was a Soviet republic.

Western economists made great efforts to estimate Soviet GDP and compare it with GDP in the United States and other Western countries. Comprehensive research in this area, initiated by Abram Bergson in the 1950s, was later conducted by the Rand Corporation and various U.S. government agencies, primarily the CIA. This work continued until the collapse of the Soviet Union in 1991. The core of the CIA research was the analysis of a large variety of production indicators measured in physical units and input-output tables. For example, to measure industrial output, the CIA studied 312 products (Madison, 1998). The CIA estimates showed that the Soviet official growth figures were exaggerated and inflation was underestimated.

The CIA methodology for aggregating various outputs measured in physical units faced harsh criticism. According to Bergson (1997), the focus of the criticism was the failure to adequately take into account the huge gap in the quality of goods and services between the United States and the Soviet Union. This, admittedly, resulted in the overestimation
of Soviet GDP by the CIA. Partly in response to this criticism, the CIA lowered its estimate of Soviet GDP for 1990 by about 10%. An alternative estimate by the European Comparison Program (ECP) reduced the Soviet GDP by almost one-fifth compared to the revised CIA figure. One reason for the better measurement of quality in the ECP calculations, as Bergson argues, was the use of Austria as a “bridge” country for the comparison of quality in the Soviet Union and in the West in general.

After the collapse of the Soviet Union, most of the former Soviet republics began to develop comprehensive Western-style national accounts, following recommendations and, sometimes with direct assistance, from international organizations, such as the World Bank and the IMF.

The adoption of the Western methodology was, however, complicated by the lack of financial and human resources in transition countries’ statistical agencies, as well as by the growing importance of the types of economic activity that are inherently difficult to measure. In fact, according to World Bank statistical experts (Belkindas, Dinc, Ivanova, 1999), economic data quality generally worsened in transition countries during the early stages of market transformation. Despite the large-scale efforts to improve the measurement of macroeconomic phenomena, including the adaptation of the SNA, the ability of statistical agencies to provide quality data still leaves much to be desired in many transition countries, especially in those that have not integrated with the European Union.

The transition has resulted in changes in the nature of statistical measurement errors. Belkindas, Dinc, and Ivanova name the following key problems leading to the low quality of basic data in transition countries. First, because of less government control, enterprises became less willing to provide data to statistical agencies. Second, enterprises have an incentive to underreport production and profit figures to lower their tax obligations. Third, the collapse of the command system and the weakness of law

10 This may change when corporations become more interested in their stock prices.
enforcement stimulated the rise of a shadow economy.\textsuperscript{11} Fourth, market transformation gave a boost to the rapid development of small businesses. Both shadow economy and small business activities are difficult to measure, while the potential significance of measurement errors associated with them has dramatically increased.\textsuperscript{12}

Also, Russian and foreign economists have frequently argued that the avoidance of taxes through transfer pricing has resulted in the overestimation of the share of the services sector (particularly, the trade sector) in GDP and the subsequent underestimation of the share of extractive industries. The official sectoral breakdown of Russian GDP shows that Russia is a services economy. In 2003, services accounted for 53.5\% of GDP and 59.7\% of total value-added. At the same time, according to the World Bank (2004a), the Russian national accounts show that the share of the oil and gas sector in GDP is about 9\%, while based on oil-and-gas export revenues, it should be about 20\%. This low reported direct contribution of the oil-and-gas sector to GDP is considered inconsistent with the prevailing view that the Russian economy is natural-resource-oriented. The World Bank study claims that trading companies may be able to pay less in taxes than goods-producing companies. Therefore, an oil-producing company may sell oil to a trading company at a price below the market price. The trading company would subsequently sell the oil to the final client at the market price.

Some major output measurement problems in Russia may have been inherited from Soviet times. Gaddy and Ickes (1999 and 2002) argue that manufacturing output in the Soviet Union was overpriced, while raw materials were underpriced. They show that the significant price distortions that resemble those in the Soviet period are present in Russia despite price liberalization. The manufacturing sector continues to be generally “value-destroying”, while the extractive sector continues to pump value-added into the system.

\textsuperscript{11} Åslund (2000) argues that the share of the shadow economy in Russia rose from 12.0\% of GDP in 1989 to 41.6\% in 1995. In the Czech Republic, it also increased, though less significantly – from 6.0\% in 1989 to a high of 17.6\% in 1994.

\textsuperscript{12} Many types of important data related to small businesses become available with a long delay, sometimes exceeding a year. Recently, this has apparently resulted in the underestimation of industrial growth in Russia (CMASF, 2005).
which was the case in the Soviet Union. Value destruction means that revenues are below the cost of material inputs (intermediate goods).\textsuperscript{13} As a result, a \textit{virtual economy} exists in Russia that is characterized by “the pretense that more value is produced than is actually the case” (Gaddy and Ickes, 1999, p. 80). Thus, both industrial production and GDP in Russia are exaggerated.

The fact that the Russian manufacturing sector is not competitive can be demonstrated, for example, by the miniscule share of its stock market capitalization in overall stock market capitalization, while the oil and gas, electricity, and telecommunications companies account for almost all stock market capitalization. The situation with employment breakdown is, however, just the opposite.

The transition to Western statistical methods and adaptation to the coverage of new economic phenomena required major revisions in many macroeconomic time series, including national account series, which often made revised data inconsistent with non-revised. The last of the major national account revisions in Russia was implemented at the beginning of 2003, when national account data were for the first time estimated in base-year prices. Before, to estimate the real growth of GDP and its components, Rosstat had used the previous year’s prices. Also, separate real goods and services exports and imports series were introduced. Prior to 2003, only real \textit{net} exports had been estimated. In addition, Rosstat made adjustments to national accounts based on new retail sales, paid consumer services, activity of non-commercial organizations serving households, and balance of payments data. The revised quarterly national account series begin in 1995. They are inconsistent with quarterly national account data for years prior to 1995.\textsuperscript{14}

\textsuperscript{13} This is a more severe problem than loss-making, which is equivalent to saying that revenues are less than the costs of material inputs, capital and labor combined. Therefore, an enterprise can be loss-making without being value-destructive.

\textsuperscript{14} At the initial stages of this research, the applied national account series began in 1994.
Data revisions, including those related to national accounts, may also be made as part of the normal process of statistics improvement.\textsuperscript{15} Such revisions are routine in countries with developed national account systems, including the United States. Although changes may still be significant, they do not usually make the non-revised portion of the time-series inconsistent with the revised portion. Some of these revisions cover one quarter, others affect several years of quarterly observations. The revision of Russian national accounts that was completed in February 2005 affected quarterly data for 2001-2004. The changes in national account data were made, primarily, on the basis of the recently developed input-output tables, new data received by Rosstat from regional statistical agencies, new government budget data, and the balance of payments data. For total GDP, the February 2005 revisions were not substantial – the average absolute value of the difference between the revised and old quarterly GDP growth rates is only 0.17 percentage point. The revisions were much more significant for individual GDP components. For example, for total investment and agriculture growth, the average difference between the revised and old indices was, respectively, 2.9 and 1.5 percentage points in absolute terms.\textsuperscript{16} Despite the February 2005 revisions, Rosstat considers the data for 2001-2004 comparable with the data for 1995-2000.

Consistent Western-style quarterly national account series in Armenia start in 1993; i.e., they are longer than in Russia. Armenian real national account variables are calculated in base-year prices. The NSS still does not estimate real exports and imports separately. Instead, as Russia did until the 2003 revision, the NSS provides real trade balance data.

\textsuperscript{15} In many countries, the publication of preliminary and revised national account data follows a strict schedule. In Armenia, for example, the NSS publishes quarterly national account figures on the 60\textsuperscript{th} day after the end of the quarter. The results of the first revision are published 115 working days after the end of the quarter. The results of the second revision and of the final revision are released more than a year after the end of the quarter. In Russia, the schedule of national account releases appears less strict.

\textsuperscript{16} The discrepancies in the total investment indices resulted from the revisions in both fixed investment and inventory data, but inventory revisions were particularly significant. In general, change in inventories is one of the GDP components that are especially difficult to measure even in developed countries (Klein, 2000).
Consistent quarterly national account series estimated in base-year prices start in 1995 in the Czech Republic.

Transition countries’ statistical agencies experience major difficulties in adequately estimating not only output, but also many other key macroeconomic indicators, such as wages, personal incomes, and employment. For example, in Russia, officially reported wages are *accrued* wages and not necessarily *paid*, due to the persistence of wage arrears, although it is a much smaller problem now than it was several years ago.

Personal income also appears overestimated due to the overestimation of savings. One of the key problems is the estimation of hard currency savings. Russian Economic Trends (1997) noted that official statistics include in savings *gross* commercial bank sales of hard currency to individuals, while it would be more appropriate to take into account only *net* sales. In addition, some hard currency is used by shuttle traders and tourists abroad. The fact that the purchases of hard currency for spending abroad by tourists are counted as savings does not affect personal income, but reduces the consumption estimates.

Another major problem is with employment data. In Russia, as well as in many other CIS countries, if an enterprise faced a decline in sales, it did not necessarily lay off employees. They remained technically employed, but actually worked part-time or did not work at all. One explanation is the paternalistic attitude of managers to their workers (Gaddy and Ickes, 2002). This can probably explain why during the post-1998 crisis recovery in Russia, the rise in employment was sluggish. In 2003, real GDP was 29.9% higher than in 1999. In the meantime, employment increased only by 4.9%. It is likely that the number of hours actually worked increased much more significantly. In Armenia, problems with employment data that are typical for the CIS are aggravated by the fact that the employment data prior to the 2001 Census are inconsistent with the post-Census data.

Registered unemployment in Russia and, in general, in most of the CIS is also misleading and significantly underestimates the actual level of unemployment, since many
unemployed choose not to register. Fortunately, in this case, a more informative indicator can be found. This is unemployment measured according to the International Labor Organization (ILO) methodology. On average, in 2003, 1.6 million people were registered as unemployed in Russia, while the number of the ILO-defined unemployed was almost four times higher. Armenia publishes only annual unemployment figures estimated according the ILO methodology.

In this study, for some countries, I do not use some of the indicators that are traditionally applied in the West as leading or coinciding, such as housing building permits, change in consumer installment debt, and the spread between a ten-year bond interest rate and a short-term central bank reference rate. In some cases, the statistical agencies in Russia and Armenia do not monitor such indicators on a regular or frequent basis. Sometimes, this lack of data is due to the fact that some markets in Russia and Armenia are virtually non-existent or underdeveloped, such as the consumer credit market or the long-term debt market.

Since changes in the hired labor utilization rates have, apparently, been significant, and the employment indicator does not reflect these changes, it might be useful if Rosstat, the NSS, and the CSO provided data related to the average number of hours worked per week in manufacturing, one of the Conference Board’s leading indicators. Unfortunately, they do not publish any high-frequency data on hours worked. Data related to initial unemployment claims, another leading indicator of the Conference Board, are virtually useless in Russia or Armenia because, as mentioned before, registered unemployment accounts for too small a portion of actual unemployment.

While in Russia, the national account series start later than most of the monthly indicator series, in Armenia, it is the consistent series of explanatory variables – production, balance of payments, money supply, income, government budget, prices, etc. – that are short. Because of the shortness of the series of explanatory indicators, the historical sample that is used in the Armenia model starts at the beginning of 1997. Monthly agricultural and industrial production series broken down into sub-sectors as well as data
measured in physical units with several exceptions start several years after 1997 or do not exist at all. Therefore, unlike in the Russian model, I used only one physical unit indicator—electricity production, which is, however, highly important in Armenia, since in dram terms, the sector accounts for almost 20% of all industrial production. In the Czech Republic, many important monthly series begin in 1995, the first year of the national account series. However, some important series, such as housing permits and many financial market indicators, start much later. These series were not used in the Czech model.
Chapter 2. Literature Review

This chapter describes the place of the model developed in this dissertation among other approaches to macroeconomic forecasting, compares the costs and benefits of the methodology applied here with those of several other methods, and discusses applications of this approach. Literature related to data issues is discussed in the previous chapter. The next chapter talks about economic growth and its factors in the countries studied in this dissertation.

2.1. Accuracy of Macroeconomic Forecasting

After World War II, many economists in the United States and other countries tried to predict economic developments associated with transition from war to peace. During the two decades following the War, large-scale econometric forecasting models were built, whose initial predictions appeared more accurate than anticipated. Gradually, however, economists’ interest in model forecasting diminished. According to Klein (2000), this was, in large part, due to growing demand for forecast precision that many existing models could not meet. Diebold (1997) argues that in the 1970s, the dissatisfaction with forecasting, in general, and the existing forecasting approaches, in particular, was caused, primarily, by two factors: disappointment with the Keynesian theoretical foundations of the forecasting models and the inability of these models to predict important macroeconomic phenomena, first and foremost, the co-existence of high unemployment and high inflation.\footnote{It was, however, well-established that this co-existence resulted from supply-side shocks (e.g., in oil markets). This supply-side effect was, in fact, consistent with the large-scale model forecasts.}

The disappointment with forecasting accuracy served as an impetus to several directions in forecast improvement research. Diebold (1997) provides a brief and comprehensive overview of this effort. One direction has been the development of the non-structural approach, which is not explicitly based on economic theory. A breakthrough in non-
structural economic modeling and forecasting took place before the development of the Keynesian structural models: in the 1920s, Slutsky (1927) and Yule (1927) showed that stochastic difference equations could be used as a powerful tool in economic and financial forecasting. In the 1970s, non-structural forecasting received a boost as a result of the growing dissatisfaction with Keynesian structural forecasting. The key contributions include, but are not limited to, the work by Box and Jenkins (1970) on stochastic trend and ARIMA models, Sargent and Sims (1977) and Geweke (1977) on dynamic factor modeling (see Section 2.6 for a description of the Stock-Watson model, an application of dynamic factor modeling to coincident and leading indicators), and Sims (1980) on vector autoregressions (see Section 2.3).

Dynamic stochastic general equilibrium modeling has been another major direction in the effort to improve forecasting. This approach is structural and is based on neoclassical economics. One of the most important features of dynamic stochastic general equilibrium modeling is stochastic dynamic optimization that makes this approach not subject to the Lucas critique.18 Real business cycle models, which link business cycles to technology shocks (see, for example, Kydland and Prescott, 1982), are a major branch within this approach.

A significant effort was made, especially within the framework of non-structural methods, to establish standards of forecast accuracy. For example, Nelson (1972) evaluated the forecasting performance of the FRB-MIT-PENN (FMP) model, a large-scale Keynesian-type macroeconomic model. He argued that simple ARIMA models that contain information only on the history of the forecasted variable is a logical choice for a standard of accuracy of a complex model that contains information on a large variety of endogenous and exogenous variables, such as the FMP model. Nelson showed that the ARIMA models did, in fact, generally provide better out-of-sample forecasts than the FMP model. In-sample accuracy also improved when the FMP and ARIMA predictions

18 The Lucas critique argues that the Keynesian type of modeling is not appropriate for conditional forecasting since it does not assume that economic agents change their decision rules in response to economic policy changes.
were combined to estimate composite forecasts. This means that the FMP model underutilized available information.

The approach adopted in this dissertation is within the framework suggested by Lawrence R. Klein (2000), who named several directions of model improvement that have potential to increase forecasting accuracy through the timely utilization of available data. First, forecasting models should exploit serial correlation in time series. Second, forecasting models should become closer to real-time frequency; i.e., they should allow for the incorporation of data within a short interval after they become available. Third, a model that is designed to provide medium and long-term forecasts should be based on “good initial conditions” (p. 44). These recommendations can be applied to structural modeling that follows various theoretical approaches as well as to non-structural modeling.

As mentioned in Chapter 1, this model attempts to exploit identified trends and patterns in the residuals, including serial correlation. Thus, it directly follows the first of Klein’s recommendations above.

In this model, national account variables are forecasted when all the information on the explanatory variables for the current quarter is available (current-quarter forecasting) and when all the data for the previous quarter are available, but no data for the current quarter have yet been released (one-quarter-ahead forecasting). Although this is not a fully real-time model, it can be extended to become such; i.e., to include incomplete current-quarter data, which would lead to a series of intermediate cases compared to the two cases considered in this dissertation. Incomplete data can be used to forecast explanatory variables, such as “special” indicators and principal components, for a full quarter. This two-step approach is applied, for example, in the U.S. high-frequency model developed by Klein and his associates (see Klein and Sojo, 1989, and Klein and Park, 1993, for example). National account variables can also be forecasted directly, in one step, based on incomplete data. The latter method is used in the U.S. Treasury model (see Section 2.10).
The model developed in this dissertation is short-term. However, one of its main objectives is to provide initial conditions for structural medium-term and long-term models. The integration of such models is described by Klein and Kushnirsky (2004) (see Section 2.9). Thus, the model presented here can serve as the foundation for models built according to Klein's approach described above.

The model presented in this dissertation is non-structural. It does not use economic optimization theory. However, as Klein and Park (1993) noted, this approach is based on social accounting, which is a branch of economic analysis. The selection of equations and explanatory variables is not arbitrary. The model forecasts separately the key national account variables on the expenditure side, production side, and income side, and integrates the GDP component forecasts into the single forecast of real GDP. As mentioned before, the “special” variables used in “bridge” equations are those that national account statisticians watch especially closely when they estimate the respective national account variables. The monthly indicators from which principal components are extracted cover the key aspects of the economy. They include indicators that are considered important factors behind economic growth identified by other studies, such as the world oil price in the Russian case, as well as indicators that serve as leading and coincident in the U.S. Conference Board-type of forecasting (see Section 1.1). The fact that this short-term high-frequency model can be applied as the foundation for a long-term structural model is another important link to economic theory.

Similar to the Nelson study, this dissertation compares the accuracy of forecasts obtained through complex models – regressions that include principal components, “special” indicators, and other variables described in Section 1.1 – with the accuracy of projections generated by simple models. In this dissertation, however, both the complex and simple models are non-structural. At the same time, the simple models considered here are more complex that the ARIMA regressions used by Nelson. In addition to AR and MA terms, they include an explanatory variable that may have a substantial impact on the dependent variable. These explanatory variables may be “special” indicators, variables that are frequently viewed as drivers of economic growth, including the world oil price for Russia.
and labor income from abroad for Armenia, and indicators that are considered factors behind the growth of the forecasted national account variable, such as wages for household consumption.

2.2. Simple Linear Regression

The forecasting of total GDP on the basis of several separate estimates (direct, as well as through its components) is an important distinction of the method applied in this study from forecasting based on a single explanatory variable or on a few explanatory variables, as well as from the Stock-Watson and other index approaches. As Klein and Kushnirsky (2004) argue, estimation diversification reduces the risk of forecast error. The averaging of GDP forecasts has proven useful in reducing forecast error in similar high-frequency models constructed for other countries, such as the United States and Mexico.

The method of principal components, another key methodological approach applied in this study, is more appealing than simple linear regressions for at least three reasons. First, it allows for a significant reduction in the number of independent variables in a regression, which is especially important for transition economies because of the shortness of time series. Second, since the principal components by design are not linearly correlated with each other, the multicollinearity problem is not encountered. Third, since the principal components are ranked according to how much variation in the original indicators they explain, the method of principal components allows for utilizing only relatively important information, while disregarding “excess baggage”.

A typical approach to the forecasting of U.S. quarterly GDP using a simple linear regression with monthly indicators as independent variables can be found in Ingenito and Trehan (1996). First, various combinations of indicators from the original set of 34 monthly indicators were tested for their power to forecast GDP in a multi-factor regression. It was concluded that the best out-of-sample forecasts were produced by a regression with employment and consumption. Second, the two selected monthly
indicators were forecasted through other variables when some values of the former were not available for the full quarter.

There have been numerous attempts to forecast Russian GDP using simple one-factor or two-factor regressions. For example, a study conducted by the IMF (2002) concluded that industrial production was the best coincident indicator for Russian GDP, while the real exchange rate was the most significant leading indicator. According to the IMF study, the ruble’s real appreciation negatively affected GDP and industrial production with a one-quarter lag. Oil prices were also found to be an important factor contemporaneously affecting Russian GDP. Their impact was estimated as positive. The study conceded that there had to be other important growth factors, which would be difficult to measure, such as technological improvements and structural changes.

Chapter 3 demonstrates that simple, one-factor regressions may have high adjusted R-squared coefficients, close to the adjusted R-squared of regressions that include principal components and other variables as described in Section 1.1. The problem is that there are numerous explanatory variables that have a significant impact on national account variables. Moreover, these explanatory variables may be highly correlated with each other. World oil prices apparently play a tremendous role in the Russian economy. But they are not the only factor of importance. This became especially clear in 2004 when Russian economic growth slowed despite an acceleration in world oil price growth. The method of principal components allows for the application of a large set of explanatory indicators. If properly selected, such a set may contain substantially more information related to economic growth than one or two indicators. Chapter 3 shows that out-of-sample forecasts obtained with the use of regressions that include principal components are more accurate than forecasts produced by one-factor regressions.

The method of principal components is not designed to address the problem of “noisy” data (when the data do not properly show what they are supposed to show because of collection difficulties, for example) better than simple regression. However, nothing prevents this method, like alternative methods, from being applied to contaminated data.
Some economists argue that one of the flaws of the method of principal components is that their coefficients are difficult to interpret (see Rodrigues, 1997). However, they do not need to be directly interpreted. As mentioned in Section 1.4, the partial derivatives of the dependent variable with respect to the original indicators can be calculated through the principal component coefficients and Eigenvectors. These partial derivatives are meaningful.

The method of principal components is sometimes criticized for the fact that some information on the indicators from which the principal components are extracted becomes lost since normally only a small number of principal components is applied. However, the loss of some information is a necessary sacrifice if the researcher wants to take into account information on a large number of explanatory indicators. Also, because of the ranking of principal components, the disregarded information is relatively unimportant.

Another perceived flaw is that principal components are difficult to project since they are artificially constructed variables. This study shows that they can be projected by using their serial properties and that on the basis of these projections national account variables can be forecasted. Also, if necessary, principal component projections can be obtained through forecasting the original (meaningful) indicators from which these components were extracted.

2.3. Vector Auto-Regression (VAR)

The method of principal components is designed to incorporate in a non-structural model a broad spectrum of variables. It does not preclude the usage of lagged variables. However, there are methods, such as VAR models, that are better suited for taking into account the complexity of lagged links between the variables. In addition, the VAR method has other important advantages. First, it does not require the division of variables into endogenous and exogenous, which sometimes may be arbitrary. Second, it allows for
the tracing of a response to an innovation in one variable to any other endogenous variable in the system. Third, it allows for the estimation of the relative importance of variables in explaining a selected variable (variance decomposition).

The problem is that a VAR model usually includes a relatively small number of variables. The method of principal components is space-intensive, while the VAR methodology is time-intensive. Given the shortness of time-series, sacrificing one type of intensity for the other may be required.\(^1\) One other VAR disadvantage is the significance of the order according to which variables enter the system, which is often arbitrary.

The use of a large variety of explanatory variables is especially important when a forecaster is unsure about which variables from a pool of potential predictors will play an important role in determining the behavior of the dependent variable in the future. Ignoring a potentially important explanatory variable may result in forecast errors similar to those that some researchers made in the early 1970s, when the role of energy indicators in determining economic growth in the United States was underestimated. Klein (2000) also argues that the forecasts of economic developments following the crisis of 1973-1974 that were based on models that used a rich structure of variables proved superior to the forecasts obtained from models based on relationships among a small number of variables, such as relationships between the use of energy and oil prices.

### 2.4. Richard Stone’s Approach to Principal Components

Richard Stone (1947) pioneered the application of the method of principal components to the forecasting of national account variables. He searched for a small number of common factors that could be used to explain the variance of a large number of national account variables, specifically, 17 variables representing factor income payments (such as employees’ compensation and dividends) and final expenditures (such as spending on

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\(^1\) Granger and Jeon (2003), who are generally sympathetic to the application of VAR models, admit that these models cannot accommodate a large number of variables – a 20-variable VAR model with five lags requires the estimation of 2000 parameters.
consumers’ semi-durable and durable goods and net public outlay). Based on U.S. annual data for 1922-1938, he estimated that 97.5% of the combined variance of the 17 variables could be explained by three orthogonal factors—the first three principal components extracted from these variables.\(^{20}\) He then analyzed the impact of the first three principal components on each of the 17 variables and concluded that the impact was strong for some of the variables, while for other variables the three principal components did not explain much of these variables’ movements.

Stone also attempted to interpret the first three principal components by determining what economic series may be associated with each of them. He tested the hypothesis that most of the variation in the 17 variables was explained by three factors: (1) total income; (2) the rate of change in total income; and (3) a trend term representing the underlying tendency of the economy to expand or contract. By analyzing the correlation coefficients between the first three principal components and the three factors, he found that the first principal component was closely related to total income, the second component was linked to the income rate of change, and the third component was associated with the trend term.\(^{21}\)

For a country for which the three factors considered by Stone have a strong impact on factor income payment and final expenditure variables, these variables may be forecasted from total income (GDP) figures by using Stone’s approach. In Russia, total GDP is initially calculated by Rosstat through the production-side components, while the expenditure-side and income-side components are calculated with a delay of about a month from the publication of total GDP and production-side figures. Therefore, Stone’s approach may be useful in estimating the expenditure-side and income-side figures a month before these figures are officially released.

\(^{20}\) Stone used 17 observations for 17 variables and, apparently, was not concerned about the degrees of freedom.

\(^{21}\) Stone was experimenting with an approach used in other social sciences and was not ready to develop a complete forecasting system.
The testing of Stone’s approach in the Russian case lies beyond the scope of this study. I would like to note, however, that some of the properties described by Stone hold for Russia. The first three principal components extracted from 11 income-side and expenditure-side nominal national account variables in Russia explain 97.9% of the variance of these variables. In Stone’s study, this number for the United States was almost the same—97.5%. Also, the correlation coefficient between nominal GDP and the first principal component is 0.999 in the Russian case. Stone reported a correlation coefficient of 0.995.

One of the weaknesses of Stone’s approach is that it does not go beyond national account variables – in his model these variables explain themselves through principal components. In the model presented in this dissertation, principal components are extracted from sets of key monthly indicators, not from GDP elements. Then, total GDP and its components are regressed on the principal components, “special” indicators, and other variables described in Section 1.1. Thus, the system of variables in this model is richer than that in Stone’s model. Also, since there is a lag between the publication of the explanatory indicators applied in my model and the release of national account variables, this model can estimate GDP and its components by using the official values of explanatory indicators before any of the national account data are released.

2.5. Conference Board Business Cycle Indicator Approach

The Conference Board in the United States uses a system of ten leading, four coincident, and seven lagging indicators to identify business cycle peaks and troughs. On the basis of these indicators, two groups of indices are constructed that are intended to help determine business cycle turning points. The leading, coincident, and lagging composite indices are weighted averages of the respective indicators. The turning points of leading, coincident, and lagging composite indices are expected to be observed, respectively, before, at about the same time as, and after the turning points in overall economic activity. The leading, coincident, and lagging diffusion indices are the ratios of the number of indicators whose values changed in a favorable direction during a period to the total number of indicators.
in the leading, coincident, and lagging sets, respectively. While the composite indices are designed to aggregate and smooth changes in individual indicators, the diffusion indices show how widespread across indicators is improvement or deterioration in economic activity.

Studies of Russian leading indicators have been scarce. Probably, the only comprehensive attempt to construct a system of leading indicators, similar to the system applied by the Conference Board, was made by Smirnov (2000). Smirnov considered monthly seasonally adjusted real industrial production as the variable characterizing Russian economic activity, for which he selected the leading indicators. Four turning points in industrial production development were identified for the period from January 1990 through August 2000. Industrial production was considered to reach a peak (trough) in a certain month if its value in that month was higher (lower) than its value in any of the six months before and after this month. According to Smirnov, the dynamics of industrial production in the post-Soviet Russia could be divided into four periods:

1. decline through November 1996;
2. sluggish recovery from December 1996 through October 1997;
3. decline that started in November 1997 and ended with the crisis of August-September 1998;
4. post crisis growth, which started in October 1998.

A set of 40 potential leading indicators was compiled and divided into 17 categories. The turning points for these indicators were compared to the industrial production turning points. Of these categories, only seven were found to contain indicators that could be used as the leading indicators. If a category contained more than one indicator that could be used as leading, an analysis was conducted to identify the best indicator (for example, based on the correlation with industrial production). As a result, seven indicators were selected. No indicator directly showing consumer or producer expectations was found suitable to be a leading indicator.
The industrial production turning points, on average, lagged from one to five months behind six of the seven selected indicators. For the Urals crude oil spot price, the average lag time was estimated at 15 months. In fact, the study expressed doubt that this indicator could be considered a good leading indicator at all. However, it was included in the selected set because of the general belief that world oil prices are crucial for the Russian economy.

On the basis of the seven selected leading indicators, Smirnov constructed the composite leading index following a procedure similar to the U.S. Conference Board’s methodology. By analyzing the turning points of industrial production and the composite leading indicator, Smirnov concluded that those of the former did lag behind those of the latter. Sometimes the lag was as short as one or two months. In addition to the composite index, Smirnov estimated the diffusion index and concluded that it was positively correlated with the percentage change in the composite index.

One advantage of the methodology applied in this dissertation compared with the Conference Board approach is that the former considers the impact of a broader set of indicators. Moreover, this impact is estimated not only directly for total GDP, but also through GDP components. While focused on identifying the turning points, the Conference Board approach does not assume that the indices should be constructed in such a way that would maximize the predictive power of the original indicators. The R-squared coefficients of the regressions of the measure of economic activity on the leading composite and diffusion indices are relatively low – not exceeding slightly more than 20%. Klein (2000) notes that the focus of the Conference Board approach is on the forecasting of the direction of movement, more than on its quantitative magnitude (p. 31). By contrast, the approach presented in this dissertation is designed to increase the explanatory power of the original indicators and is concentrated on the forecasting of the quantitative magnitudes of national account variables. However, it is not intended to determine business cycle turning points. While predicting an increase or a decline in GDP, it cannot say that this is a business cycle peak or trough.
A number of monthly indicators applied in this study are also used within the framework of the U.S. Conference Board approach (see Section 1.1). Principal components extracted from these monthly indicators as well as other explanatory variables are used in this study contemporaneously and with lags (usually, when contemporaneous independent variables do not appear to provide sufficient explanatory power). Thus, some independent variables act as coinciders, some as leaders, and some as both coinciders and leaders. Also, in the Russian case, I search for regressions with high predictive power that include only lagged variables. This represents a step toward creating a system of purely leading indicators based on a model using principal components.

2.6. Stock-Watson Indices

The Stock-Watson indices of coincident and leading economic Indicators (Stock and Watson, 1989) are weighted averages of two respective sets of indicators. The Coincident Index is a weighted average of four leading indicators and the Leading Index is a weighted average of seven leading indicators. Unlike in the Conference Board approach, the weights with which the coincident and leading indicators enter the Coincident and Leading Indices of the Stock-Watson model are estimated econometrically. Thus, the Stock-Watson approach is an attempt to provide a solid econometric foundation for the Conference Board-type of business cycle research.

The approach assumes that there is a “single unobserved variable” that characterizes the state of the economy and that each coincident indicator has a component associated with the single unobserved variable. The Composite Index is the estimate of the single unobserved variable, and the Leading Index is the estimate of the growth of the single unobserved variable over the next six months. In the first step, parameters of a model that links the coincident indicators with the single unobserved variable are estimated. In the second step, parameters of a VAR system that links the leading indicators with the “single unobserved variable” are estimated, conditional on the parameters obtained in the first step.
The arguments made earlier that the relative strengths of the model applied in this dissertation, such as the use of a large set of explanatory variables and GDP forecasting through several approaches (direct estimation and estimation through GDP components), are relevant in the comparison of my model and the Stock-Watson model. In addition, assumptions imposed on the Stock-Watson model may be too strict and limit its predictive power. For example, some assumptions are equivalent to stating that the sources of economic fluctuations have a proportional impact on the coincident indicators, which may be too restrictive. Empirically, this approach had one major drawback: it was unable to forecast the 1990 recession in the United States (Klein, 2000) even months after it had started.

2.7. A Medium-Term Forecasting Model of the Russian Economy

One of the most comprehensive recent models of the Russian economy was developed by the Moscow-based Center for Macroeconomic Analysis and Short-Term Forecasting (CMASF) and several other think-tanks for the Russian Ministry of Economic Development and Trade (see, for example, Mikhailenko, 2004).

The model uses about 450 variables: 100 endogenous variables are estimated through regressions, 250 endogenous variables are calculated through identities, and the remaining are exogenous. The model forecasts variables related to most of the key macroeconomic aspects, including GDP, production, income, savings, foreign trade, the balance of payments, prices, the exchange rate, the government budget, and the money supply. Exogenous variables include external variables (such as international prices), government policy variables (such as regulated prices), and "business behavior" variables (such as the ratio of wages to labor productivity). The model is designed to generate three or four-year forecasts.

The majority of the equations were estimated on the basis of the post-1998-crisis sample, as the developers of the model believed that the structural change caused by the crisis precluded the use of the pre-crisis and the post-crisis data in the same regressions.
Because of the shortness of the historical sample, many equations applied in the CMASF model contain only one or two independent variables. For example, in the transportation and communication value-added regression, the only independent variable is freight transportation. Freight transportation is, in turn, determined only by industrial production. Trade value-added depends on the volume of retail trade, which, in turn, is determined by population disposable income. Total GDP is calculated as the sum of its production-side components.

Many of the explanatory variables used in the production-side equations in the CMASF model are the same as the "special" indicators in my model. However, as it will be demonstrated in Chapter 3, the introduction of principal components in regressions applied to forecast GDP components increases forecast accuracy. Although the selected independent variables are highly significant in determining GDP components, it is problematic that the approach applied in the CMASF model does not give other important variables a chance to reveal their effects. Another disadvantage of the CMASF methodology may be the fact that total GDP is estimated only through its production-side elements. As experience in the development of high-frequency models for various countries shows, the estimation of total GDP through several approaches reduces forecast error.

An analysis of regression specifications in the CMASF model reveals insufficient use of AR terms and a complete lack of MA terms, which, as my study demonstrates, are very helpful in the forecasting of Russian national account variables. Finally, the applicability of the seasonal adjustment methods in the CMASF model is questionable given the shortness of the time series.

2.8. High-Frequency National Account Models for Other Countries

High-frequency models forecasting national accounts variables similar to the model presented in this dissertation, were developed by Lawrence R. Klein, his students and associates for several developed and developing countries, including the United States
Both national account variables and explanatory indicators vary by country model. The selection of indicators is based on data availability and the importance of explanatory variables. For example, because of its importance for Mexican GDP, the real tourism balance was selected in the Mexican model as one of the indicators in the set from which the principal components were extracted. By contrast, in Russia, tourism does not play such a substantial role, and tourism data are not available on a frequent basis. Russian national account data are often less detailed than national account data in developed countries. For example, in Russia, only total household consumption data are available, while in the United States, household consumption is broken down into durable goods, non-durable goods, and services consumption.

While the quality of Russian data may be on par with Mexican data, the quality of Armenian data is, apparently, much worse than the quality of the data applied in similar high-frequency models to date. This can be inferred, for example, from huge discrepancies in the Armenian official GDP estimates obtained through different approaches.

Important methodological differences between my model and similar high-frequency models include the following:

- In other high-frequency models using Klein’s approach, "special" indicators are almost always the only explanatory variables in regressions forecasting GDP components. In the model presented in this dissertation, principal components are used not only to forecast total GDP, but also to forecast GDP components. I show that the introduction of principal components leads to better forecasts of GDP components compared to equations that include only "special" indicators. Moreover, in general, this study systematically benchmarks the forecasts obtained

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22 Models for Thailand and China (Klein and Mak, 2004) are being developed.
though the complex model against the forecasts generated by simple one-variable equations.

- In the Russian case, I search for regression specifications with significant predictive power that include only lagged independent variables in addition to regressions that include contemporaneous and lagged independent variables. The developers of similar high-frequency models for other countries did not attempt to do this.

- In the Russian and Czech models, testing for a structural break brought about, respectively, by the August 1998 crisis and the May 1997 crisis, is routinely conducted. Individual regressions are adjusted for structural break if this helps improve forecasts. Structural break information is not always incorporated in other country high-frequency models. For example, the Mexican model does not seem to take into account that there might have been a structural break as a result of the December 1994 crisis.

- Other high-frequency models usually apply relatively sophisticated methods of seasonal adjustment or use official seasonal adjustment figures. For example, the Mexican model uses the X11 methodology. In my model, because of the shortness of time-series, I use the year-over-year indices or seasonal dummy variables. For most of the indicators applied in this study, officially released seasonally adjusted data are not available.

### 2.9. Integration of a High-Frequency Model into a Low-Frequency Model

As mentioned before, one of the objectives of the development of this short-term non-structural model is to provide good initial conditions for a medium-term or a long-term structural forecasting model. A framework for the integration of such models can be found, for example, in Klein and Kushnirsky (2004).
Since macroeconomic variables are often strongly dependent on their previous values, time-series regressions that exploit serial correlation can provide relatively accurate forecasts for several quarters ahead. Another advantage of a short-term time-series model is that it can usually be estimated on the basis of a much larger number of observations than a long-term model. Therefore, it can accommodate a significantly larger set of variables than a long-term model. Also, as Klein and Kushnirsky note, the combination of the short-term and long-term approaches diversifies forecasting tools and thus reduces the forecast error.

At the same time, the forecasting power of short-term time-series regressions quickly diminishes and a longer-term model becomes necessary if the forecast horizon is to be extended to over a year. In general, as Klein (2000) argues, established regularities that time-series non-structural models capture “often break down in crucial forecasting situations” (p. 41). In addition, while non-structural models may generate accurate unconditional forecasts, a structural model is required when a researcher is interested in the evaluation of the impact of policy changes (Diebold, 1997).

Thus, the integration of a high-frequency model into a long-term model enhances the explanatory power of the combined model. It also objectively adjusts the long-term model to estimated current and predicted near-future economic developments. The key word in the previous sentence is “objectively”, since this integration reduces or even eliminates the need for judgmental adjustments. Economic forecasters are frequently criticized for subjectively adjusting forecast values generated by long-term models for the beginning of the forecast period when they consider these values unrealistic.

Klein and Kushnirsky suggested two simple approaches for the integration of a high-frequency short-term model into a low-frequency long-term model. The first approach assumes the application of a loss function that would bring the solution of the low-frequency model close to the solution of the high-frequency model. In the second approach, the solution of the high-frequency model is used as an exogenous variable in the low-frequency model.
According to the first approach, the loss function $R$ is minimized. It is specified as the weighted sum of squared differences between the solutions of the high-frequency model and those of the low-frequency model, $Y_{ij}$ and $y_{ij}$, respectively:

$$
R = \sum_{i=1}^{n} \sum_{j=1}^{m} w_i (Y_{ij} - y_{ij})^2,
$$

where $w_i$ is the weight of the discrepancy between the solutions of the two models for the variable $i$, $m$ is the number of variables in the solution set, and $n$ is the final period of the forecast horizon of the high-frequency model. The solutions of the low-frequency model are the arguments of the loss function; thus the high-frequency model takes precedence over the low-frequency model. Beyond the horizon of the high-frequency model, the low-frequency model follows its own trajectory. The solutions of the low-frequency model that are obtained through the minimization of the loss function serve as estimates of the initial conditions.

The second approach assumes that the loss function is based on one variable. This may be the case, for example, when this is a variable of special importance, such as GDP. After the variable is chosen and its short-term forecasts are obtained through the high-frequency model, the solution of the high frequency model serves as an initial condition for the low-frequency model.

Klein and Kushnirsky described how a long-term structural model of the Ukrainian economy developed by the Institute of Economic Forecasting of Ukraine's National Academy of Sciences may be integrated with a short-term high-frequency model, which yet has to be built.

### 2.10. Application of High-Frequency National Account Forecasting to Government Decision-Making

Government agencies and business analysts worldwide monitor high-frequency information that is released on a monthly, and sometimes weekly or even daily basis, to
estimate, using formal or informal methods, lower frequency data, such as quarterly national account data, before reports on these data are released. Such estimates are important, for example, in the preparation of government budgets. The U.S. Treasury Department routinely uses GDP projections to forecast tax receipts (Kitchen and Monaco, 2003). The timeliness of these estimates may become critical near business-cycle peaks and troughs, since the government needs time to prepare counter-cyclical measures. The lag between the publication of daily, weekly, and monthly indicators, on the one hand, and the release of quarterly national account indicators, is part of the so-called “recognition lag”, the time it takes for policymakers to recognize the state of the economy. To cope with this problem, government agencies, including the U.S. Treasury, have been developing forecasting systems that allow for the incorporation of high-frequency data into forecasting models as soon as these data become available.

The U.S. Treasury Department Real Time Forecasting System (RTFS) is designed primarily to forecast current-quarter GDP growth. The core of the RTFS is a set of 30 employment, financial, production, sales, and survey monthly indicators that have a significant impact on GDP. For each indicator, the system contains three equations of GDP on the contemporaneous and lagged values of the indicators and the lagged values of GDP itself. The first regression for each indicator assumes that only information on the values of the indicator for the first month of each quarter is available. The second regression uses information on the first two months of a quarter. The third regression applies information on all of the three months of a quarter. In total, there are 90 single-factor GDP regressions.

For each indicator, the RTFS selects one of the three equations, depending on how many months of data for that indicator are available, and produces a GDP estimate. The final GDP estimate is calculated as the weighted sum of individual equation estimates produced by 30 regressions. The weight with which a GDP estimate generated by a single-indicator regression enters the final GDP estimate formula is the ratio of the R-squared coefficient for this regression to the sum of all of the R-squared coefficients in the group. Thus, the weight reflects the relative in-sample predictive power of the
indicator. Since the time of official release varies by indicator, which of the three regressions is used at a particular moment during a quarter also varies. For example, for a certain indicator, two months of data may be available when for another indicator only the first-month figure may be released. Therefore, the weights in the final GDP estimate formula evolve with the release of new data. When a new figure is published, the R-squared coefficient estimated for the regression based on the number of months of available data enters the formula, while the respective coefficient for the regression used previously for this indicator is dropped from the formula.

Kitchen and Monaco argue that the RTFS methodology is “conceptually similar to Klein’s principal components approach” (p.14). The similarity is mainly related to the fact that both apply a large number of indicators. At the same time, there are significant differences between the two. One of the main disadvantages of the RTFS is that it does not take into account how monthly indicators are correlated with each other. Each of the selected indicators contains important information that helps forecast GDP – it is proven by single-variable regressions. The problem is that since the indicators are correlated with each other, they contain overlapping information. For example, real retail sales, one of the 30 selected high-frequency indicators, may be strongly correlated with real personal income, another selected indicator. Another example is the S&P 500 index and the Dow Jones index. The RTFS method of combining single-variable GDP estimates results in signal redundancy, which is not encountered when the method of principal components is applied.

Klein’s high-frequency forecasting approach is more than just the method of principal components. The “bridge” equations in Klein’s methodology are also critically important. They allow for linking GDP elements to the key single monthly indicators that determine them. One example is household consumption of goods, on the national account side, and retail sales, on the monthly indicator side. The estimates of GDP elements are then combined to obtain several independent total GDP estimates. The RTFS generates only direct GDP forecasts.
The RTFS and Klein’s approach differ in the way they treat incomplete quarterly information. It is difficult to say *a priori* which method is better: the direct forecasting of GDP from incomplete quarterly data or the estimation of missing quarterly data from available quarterly data that precedes the forecasting of GDP. Comparative forecast accuracy testing of the two methods may be required.

**2.11. Business Applications of Principal Components Extracted from Macroeconomic Indicators**

High-frequency forecasts may help businesses in the development of production, sales, or investment plans. They may also be used by short-term speculators, since an official release of a macroeconomic indicator may have a substantial impact on commodity and financial markets. A significant portion of literature related to both macroeconomics and markets is devoted to the analysis of market responses to macroeconomic news. Unlike many previous studies on the stock market and macroeconomics, a study conducted by Guzman (2003) focused not on the impacts of announcements of individual macroeconomic indicators, but on the aggregate perception of macroeconomic news.

Guzman developed a multivariate approach to the high-frequency forecasting of the returns on the S&P 500 Index. The model that she built can be considered an extension of Klein’s U.S. high-frequency forecasting model. The method of principal components was one of the key methodological features. According to Guzman, investors do not know what is actual contemporaneous economic growth. However, they continuously receive news on macroeconomic indicators that serve as signals of current and near-future economic growth. On the basis of these signals, they form investment risk perceptions, which, in turn affect the equity market.

This perception was considered a function of principal components derived from 30 macroeconomic indicators covering key aspects of the economy, including production, sales, employment, government budget, interest rates, and prices. The macroeconomic block was one of the three blocks of indicators that explained the S&P 500 Index.
Investors’ sentiment indicators and the indicators describing investors’ hedging strategies (S&P 500 futures market indicators) were combined in the other two blocks.

For various S&P 500 Index return horizons (from the one-day return to the one-month return), the predictive power of the method of principal components applied to aggregate information on individual macroeconomic indicators was tested against the inclusion of several key macroeconomic indicators in one regression. The conclusion was made that the predictive power of the former is stronger than that of the latter.

In Russia, there have also been studies analyzing the impact of individual macroeconomic indicators on stock prices. For example, Grigoriev and Valitova (2002) showed that the influence of such potentially important indicators as real industrial production, consumer prices, and the world oil price on Russian stock prices was virtually absent. This is not surprising, taking into account the underdevelopment of the Russian stock market. It is possible, however, that a model aggregating the impact of a large variety of macroeconomic indicators on stock prices would show that this impact is not negligible.

2.12. Application of the Method of Principal Components to the Analysis of the Consistency of Economic Growth Figures with Other Indicators

Economists studying economic growth in China have frequently expressed skepticism of Chinese national account statistics (see, for example, Rawski, 2001, and Movshuk, 2002). Some claim that the official figures overestimate Chinese economic growth in the late 1990s and in 2000 and that it is even possible that the Chinese economy contracted in 1997-1998. One of the key arguments in favor of this hypothesis was a decline in energy consumption during the period in question. The suspicion that China exaggerated its growth, in turn, led to studies discussing problems with Chinese energy statistics that possibly resulted in the underestimation of energy consumption or in the overestimation of growth, as well as studies pointing out that trends in other indicators, such as
government revenues and imports, were consistent with the official economic growth statistics.

Klein and Ozmucur (2003) argued that no single indicator could explain movements in such a complex variable as GDP. Instead of comparing trends in one or two indicators with the dynamics of Chinese GDP, they tested whether changes in Chinese GDP were consistent with changes in a large set of indicators.

To do this, they selected indicators covering a broad spectrum of macroeconomic aspects including the production of key commodities measured in physical units, foreign trade figures measured in constant U.S. dollars, and labor market indicators. From this set of indicators they extracted principal components. Klein and Ozmucur concluded that the Chinese official annual GDP growth rates were generally close to the GDP growth rates estimated with a regression on the principal components and ARMA terms. Substantial discrepancies between the official and estimated GDP figures were observed in 1989 and 1990, which was expected because of the political unrest during that period. Out-of-sample forecasts were also close to the official figures. To confirm the findings based on the equation with annual figures, they estimated similar regressions for the monthly manufacturing index and quarterly GDP.

As a result, a conclusion was made that the dynamics of the official GDP figures were consistent with the dynamics of principal components that contain information about a large variety of indicators. It was stressed, though, that this conclusion did not mean that the official statistics measured GDP correctly.

As mentioned in Section 1.5, there have, recently, been accusations in the Russian media that Rosstat has intentionally exaggerated GDP growth, which is a politically sensitive figure. The approach suggested by Klein and Ozmucur may be applied to show whether the officially released GDP figures are consistent with other indicators.
2.13. Application of the Method of Principal Components to Abstract Conceptual Variables

GDP and similar aggregate production variables cannot measure such broad concepts as the quality of life. In fact, it may not be generally appropriate to measure composite quality level variables by simply aggregating their components. Meanwhile, interest in developing estimates of such variables has been strong in many fields.

For example, international organizations, such as the United Nations, attempt to measure where countries stand according to the level of development. For this purpose, the United Nation Development Program (UNDP) calculates the Human Development Index (HDI) based on three indicators: life expectancy at birth; the weighted average of the adult literacy rate and the education enrollment ratio; and per capita GDP in purchasing parity terms (UNDP, 1999). The HDI is obtained as the simple average of the three indicators. Other organizations and individual researchers have proposed different sets of the indicators for the calculation of human development measures (see, for example, Morris (1979)). However, the common approach was the simple averaging of the indicators and/or assigning more or less arbitrary weights to them.

Nagar and Basu (2002) proposed an alternative to the subjective methods of combining individual socio-economic indicators into a human development index. The Nagar-Basu index is the weighted average of the principal components extracted from socio-economic indicators, where the weights are the variances of the respective principal components. Thus, this method assigns the weights objectively, according to the relative importance of principal components.

The index was computed for 1999 based on two sets of socio-economic indicators for two country groups. For the larger country group, which included 174 countries, the four UNDP HDI indicators were used. For the other, smaller group of countries, Nagar and

\[23\] The per capita GDP measure is “capped” at upper-income levels by UN statisticians. An increase in GDP leads to an increase in the HDI only up to a certain point.
Basu used a larger set of indicators. The method allowed for the ranking of the countries based on their human development standing, as well as for the measurement of the relative importance of the selected socio-economic indicators for human development.

The key difference between the application of the method of principal components to national account variables in my model or to stock price index returns in the Guzman model, on the one hand, and its application to abstract conceptual variables, such as human development, on the other hand, is that in the former group of models the actual values of the studied concepts are observed directly or through proxies, while in the latter group the studied concepts cannot be observed, by definition. Thus, the weights (coefficients) of principal components in my model can be estimated econometrically, while in the Nagar-Basu approach, they have to be assigned, though objectively. Another difference is that in my model, the approach is time-series, while in the Nagar-Basu model, it is cross-sectional.24

Klein and Ozmucur (2003) noted that the Nagar-Basu approach may be applied to the adjustment of price deflators for quality improvements in China. The official growth rates may underestimate the remarkable improvements in the quality of goods and services in that country since the late 1970s. A similar study may be useful for other transition countries. Unlike in China, though, quality improvements in Russia were probably not so widespread across the sectors of economic activity. While significant improvements in the quality of consumer goods as well as in the quality of some types of services, such as retail trade, have taken place in Russia since the beginning of transition, it is questionable, for example, whether the general quality of education and health care has improved.

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24 Nagar and Basu have applied their techniques to cross-section (i.e., cross-country) samples, because many indicators are not available as time-series. However, recently, they have also applied their method to time-series for a number of important Indian states.
Chapter 3. High-Frequency Models for Individual Countries

3.1. Russian High-Frequency Model

3.1.1. Russian Economic Growth and Its Factors

The Russian economy dramatically contracted after the collapse of the Soviet Union in December 1991 and the beginning of widespread market transformation. In 1995, the first year of the historical sample used in this study, Russian GDP stood at only 65.4% of the 1991 level. Contraction continued in 1996. After a mild recovery in 1997, GDP plunged again in 1998 (see the discussion of the 1998 crisis in Section 1.3). In 1998, GDP reached its nadir – 60.5% of the level posted in the last year of the Soviet Union. Judging by the official numbers, the depression in the former Soviet Union in the 1990s was among the most severe in the industrialized world. During the Great Depression, from 1929 through 1933, the U.S. economy contracted 30.5%, less than the Russian economy from 1991 through 1998.\(^\text{25}\)

Since 1999, the Russian economy has been experiencing strong economic growth – on average, GDP increased 6.7% a year in 1999-2003.\(^\text{26}\) Some economists consider the post-crisis period as one of the most successful in Russia's post-World War II economic history (see, for example, Belousov, 2004). Nevertheless, in 2003, Russian GDP was still 16.4% below the 1991 level.

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\(^{25}\) It is often argued that the magnitude of the post-communism economic contraction in the former Soviet Union and Eastern Europe was exaggerated, to a great extent because statistical agencies underestimated the contribution of the shadow economy and small businesses (see, for example, Åslund, 2000).

\(^{26}\) The strong growth was accompanied by a rapid rise in labor productivity measured on the basis of employment. The problem is that the slow rise in employment apparently underestimates an increase in the number of hours actually worked.
GDP rose about 7% in 2004. However, after posting 7.5% year-over-year in the second quarter of 2004, quarterly economic growth decelerated, though still remaining close to 7%. The slowdown was, apparently, more substantial in the first quarter of 2005.

**Figure 3.1.1.1. Russia: Annual Real GDP and Price Growth Rates (%)**

Compared to the early years of market reform, Russia has achieved remarkable success in restraining inflation. After posting triple-digit figures in the early 1990s, the rise in the GDP deflator slowed to 15.1% in 1997. Following an outburst during and immediately after the 1998 crisis, inflation cooled down to 13.7% in 2003. However, GDP deflator growth started to accelerate again in the fourth quarter of 2003, reaching 20.1% year-over-year in the third quarter of 2004.

Despite the continued strong growth, the prevailing attitude of Russian economists toward the recent macroeconomic developments is that of disappointment. First, the economy is expanding from a low base, and the high growth rates are often taken for
granted. Second, the situation has been worsening on both the growth and the inflation fronts. Finally, and most importantly, the external environment – first and foremost, high and rising world oil prices – is considered extremely favorable, and the widespread view is that Russia has not been able to take a full advantage of it. This leads us to the discussion of the factors of economic growth in Russia.

*Figure 3.1.2. Russia: Quarterly Real GDP and Prices (1995Q4 = 100)*

World oil prices, or sometimes the international prices of the main exported commodities, as well as the real ruble/U.S. dollar exchange rate have been generally considered the key factors behind economic growth in Russia since the mid-1990s. Other factors are often mentioned as having secondary or transitory importance. For example, the IMF while assessing Russian economic performance prior to the second half of 2004, stated that strong growth was caused by high energy prices, though "the rise in investment is likely

27 Year-over-year economic growth is now almost certainly below the magic number of 7.2% – the growth rate needed to double GDP in ten years, the target set by Russian President Vladimir Putin.
also to have been due to political stability, generally sound macroeconomic policies and some structural reforms” (2004c, p.5). The disappointing growth performance that accompanied the oil price rise in the second half of 2004 has been blamed on supply disruptions in the oil sector and the deterioration of the investment climate (IMF, 2005a).

Going back several years, the overvalued ruble and the decline in the world prices of oil, natural gas, and steel prices are generally thought to have aggravated the fiscal mismanagement problems that led to the 1998 crisis. The recovery from the crisis, as the IMF argues, resulted primarily from import substitution, which combined with high oil prices, had a favorable impact on net exports and profits (IMF, 2002, p.7). Higher profits, in turn, stimulated investment demand in the export sector. The increase in investment led to the rise in the marginal product of labor and, consequently, in wages, which stimulated consumption demand. Also, investment played a role as a supply-side factor in boosting production.

As mentioned in Chapter 2, the IMF (2002) estimated the impacts of the exchange rate and world oil prices on Russian GDP using simple regressions and concluded that these impacts were strong, while admitting that there were other economic growth factors. Also, the World Bank (2003) provided a quantitative assessment of the contribution of world oil price changes to Russian GDP growth. The study demonstrated that oil prices were the key factor behind economic growth. The impact of oil prices on GDP (with a one-month lag) was calculated through the elasticity of GDP with respect to oil prices. The World Bank report claims that oil prices accounted for 5.9 percentage points of the 10% rise in GDP in 2000. A decline in oil prices, contributed slightly to the slowdown of economic growth in 2001 and 2002. Without this decline, GDP growth would have been 5.1% instead of the reported 5.0% in 2001 and 5.2% instead of 4.3% in 2002. In the

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28 Since the methodology behind this assessment was never made public it was not discussed in Chapter 1.

29 The official GDP growth rates are provided here as they were known at the time of the publication of the study. They were later revised by Rosstat.
first half of 2003, oil price contribution was positive again, and economic growth accelerated to 7.2%. The contribution of oil prices was three percentage points.

In addition to research that assesses the impact of oil prices while accepting official statistics at face value, there have been studies showing that official data substantially underestimate the role of the energy sector. Some of these studies were discussed in the overview of Russian output measurement problems in Section 1.5. From the conclusion made by Gaddy and Ickes (2002) that the oil and gas sector pumps value into the economy, while most of the manufacturing sector destroys value, it follows that the manufacturing sector is a burden on the Russian economy (p. 2) and that Russia might, in fact, benefit from a manufacturing sector decline.

Russian economists generally agree with the international financial organizations’ analysis of the factors of economic growth. For example, Andrei Belousov (2003), currently an economic advisor to the Russian Prime Minister, Mikhail Fradkov, also named high oil prices and the ruble's real depreciation as the main drivers of Russian economic expansion after the crisis. Belousov added that during the first years after the crisis the impact of these two factors was strengthened by the presence of considerable unused capacity, in terms of both equipment and labor. By 2002, the capacity utilization rate had markedly increased and the ruble had appreciated, making the Russian economy more reliant on world oil prices.

Belousov also claimed that according to the estimates obtained through "econometric modeling", an increase in the world price of Russian oil by $1 per barrel resulted in the acceleration of Russian GDP growth by one half of a percentage point.30 A later assessment of macroeconomic developments in Russia provided by the think-tank headed by Belousov reduced the impact of a $1 per barrel increase in oil prices to a 0.3 percentage point acceleration in GDP expansion (CMASF, 2005). However, the study argued that this assessment was made on the basis of pre-2004 data. Given the actual oil

30 No detail regarding the model was provided.
price increase, GDP growth should have been 9% in 2004, about two percentage points higher than it probably was.

The problems with curbing inflation over the past several years have also been linked to world oil prices and the exchange rate. It is believed that at the early stages of market reform, inflation was caused primarily by price liberalization and government subsidies. Inflation that has been observed since shortly after the crisis is considered to be mainly a result of the Central Bank’s policy of slowing the ruble's real appreciation. Export revenues boosted by high oil prices exert upward pressure on the ruble. In order to protect domestic producers, the Central Bank purchases foreign currency, which raises the money supply. This, in turn, stimulates inflation. The IMF (2005a) argues that the Central Bank usually opts for preventing too significant an appreciation of the ruble even if it leads to exceeding the inflation target. Of course, world oil prices also affect Russian inflation directly through domestic crude oil and oil product prices. The trade-off between inflation and the ruble's real appreciation (and, ultimately economic growth) is one of the most hotly debated issues among Russian economists.

The unique role of oil prices in determining Russian economic growth can be explained by the share of oil exports (including both crude oil and oil products) in total merchandise exports. In 1995, this share stood at 22.2%. By 2004, it almost doubled, reaching 43.8%. The share of natural gas, the second most important commodity was 11.9% in 2004.

Figure 3.1.1.3 illustrates that the Russian economy might indeed have suffered from low world oil prices and benefited from high oil prices. The contraction of production that started in the first quarter of 1998 was accompanied by the fall in oil prices. The most significant decline in GDP during the entire period considered in this study occurred in the fourth quarter of 1998 when oil prices were at their lowest. The recovery from the crisis corresponded to a rapid rise in oil prices. The slowdown of economic growth in 2001 and the growth acceleration in 2002 took place when oil prices, respectively, declined and rose.
On the other hand, as Figure 3.1.1.3 shows, oil price changes do not seem to explain the short-lived pre-crisis recovery in 1997, when oil prices declined, and the relatively stable GDP growth at the end of 2003 and in 2004, when oil prices rapidly rose.

Figure 3.1.1.4 illustrates that the recovery from the crisis was accompanied by a sharp real depreciation of the ruble versus the dollar, which, as most economists argue, helped domestic producers. The strengthening of the ruble might have offset the favorable impact of high oil prices on economic growth in 2002-2003. At the same time, at the very end of the historical period, the real ruble/dollar exchange rate was relatively stable. Nevertheless, rising high oil prices did not lead to an acceleration in economic growth.
Thus, it appears that while oil prices and the exchange rate likely determine a significant portion of the long-term GDP trend, they are not sufficient to explain short-term fluctuations in economic growth. The analysis of correlations between the indices of macroeconomic variables further complicates the issue of the oil price and exchange rate impacts on Russian GDP and its elements.

Table 3.1.1.1 shows that while the correlation between the total GDP index and the oil price index was quite high, the correlations between many of the GDP component indices – most remarkably, the index of household consumption, the largest GDP component – and the oil price index were not substantial. Surprisingly, the exchange rate index was negatively correlated with the contemporaneous indices of GDP and most of its components. The correlation between the exchange rate index and the GDP index becomes positive, though, when the former is lagged.
Table 3.1.1.1. Correlations between the Indices of Russian National Account Variables and the Indices of the Brent Crude Oil Spot Price and the Ruble/U.S. Dollar Exchange Rate

<table>
<thead>
<tr>
<th></th>
<th>Brent crude oil spot price</th>
<th>Ruble/U.S. dollar exchange rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>contemporaneous</td>
<td>lagged one quarter</td>
</tr>
<tr>
<td>GDP</td>
<td>0.620</td>
<td>0.592</td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>0.619</td>
<td>0.528</td>
</tr>
<tr>
<td>Agricultural value-added</td>
<td>0.467</td>
<td>0.279</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>0.423</td>
<td>0.490</td>
</tr>
<tr>
<td>Other goods production value-added</td>
<td>0.427</td>
<td>0.482</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>0.576</td>
<td>0.682</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>0.449</td>
<td>0.264</td>
</tr>
<tr>
<td>Other market services value-added</td>
<td>0.233</td>
<td>0.197</td>
</tr>
<tr>
<td>Non-market services value-added</td>
<td>0.333</td>
<td>0.171</td>
</tr>
<tr>
<td>Net taxes on products and imports</td>
<td>0.603</td>
<td>0.543</td>
</tr>
<tr>
<td>Household consumption</td>
<td>0.119</td>
<td>0.265</td>
</tr>
<tr>
<td>Government consumption</td>
<td>0.405</td>
<td>0.171</td>
</tr>
<tr>
<td>Consumption by non-commercial organizations</td>
<td>0.078</td>
<td>0.173</td>
</tr>
<tr>
<td>Gross fixed investment</td>
<td>0.463</td>
<td>0.510</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>0.086</td>
<td>0.158</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>0.366</td>
<td>0.173</td>
</tr>
<tr>
<td>Imports of goods and services</td>
<td>0.365</td>
<td>0.521</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>0.621</td>
<td>0.407</td>
</tr>
<tr>
<td>Nominal employees' compensation</td>
<td>0.614</td>
<td>0.542</td>
</tr>
<tr>
<td>Nominal gross profit and mixed income</td>
<td>0.359</td>
<td>0.112</td>
</tr>
<tr>
<td>Nominal net taxes on production and imports</td>
<td>0.669</td>
<td>0.518</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>0.440</td>
<td>0.230</td>
</tr>
</tbody>
</table>

Table 3.1.1.2 demonstrates that a large number of indicators were more significantly correlated with GDP than were oil prices and the exchange rate. It also appears, however, that for some of these indicators the correlation with GDP declines substantially if they are taken with lags.
Table 3.1.1.2. Correlations between the Index of Russian GDP and the Indices of Selected Macroeconomic Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Contemporaneous</th>
<th>Lagged one quarter</th>
<th>Lagged two quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial production</td>
<td>0.925</td>
<td>0.830</td>
<td>0.587</td>
</tr>
<tr>
<td>Agricultural production</td>
<td>0.782</td>
<td>0.638</td>
<td>0.330</td>
</tr>
<tr>
<td>Construction</td>
<td>0.879</td>
<td>0.712</td>
<td>0.546</td>
</tr>
<tr>
<td>Freight transportation (in ton-kilometers)</td>
<td>0.797</td>
<td>0.822</td>
<td>0.789</td>
</tr>
<tr>
<td>Inventories in retail sales</td>
<td>0.694</td>
<td>0.400</td>
<td>0.129</td>
</tr>
<tr>
<td>Cement production (in physical units)</td>
<td>0.680</td>
<td>0.659</td>
<td>0.653</td>
</tr>
<tr>
<td>Crude oil production (in physical units)</td>
<td>0.664</td>
<td>0.602</td>
<td>0.483</td>
</tr>
<tr>
<td>Electricity production (in physical units)</td>
<td>0.723</td>
<td>0.563</td>
<td>0.321</td>
</tr>
<tr>
<td>Steel production (in physical units)</td>
<td>0.813</td>
<td>0.807</td>
<td>0.655</td>
</tr>
<tr>
<td>Merchandise exports (in U.S. dollars)</td>
<td>0.676</td>
<td>0.544</td>
<td>0.369</td>
</tr>
<tr>
<td>Brent crude oil spot price</td>
<td>0.620</td>
<td>0.592</td>
<td>0.478</td>
</tr>
<tr>
<td>Ruble/U.S. dollar exchange rate</td>
<td>-0.305</td>
<td>0.037</td>
<td>0.318</td>
</tr>
</tbody>
</table>

The following sub-section extends this analysis and shows that multi-factor high-frequency models may be better suited for short-term forecasting than simple single-variable models, even though those single factors may be highly important. This study is not intended to prove or disprove that world oil prices, the exchange rate, or any other single indicator is the key factor determining Russian economic growth. It shows that forecasting accuracy improves if the model takes into account signals from a large variety of sources. Specifically, it predicts the disappointing economic growth performance in the second and third quarters of 2004. It is possible that oil prices play an important role in determining, contemporaneously and with lags, most of the indicators applied in the constructed multi-indicator models. But, regardless of whether they are generally determined by oil prices or not, these indicators contain valuable information that will be lost for forecasting if the model is built solely on the basis of a single variable, such as oil prices.
3.1.2. Russian National Account Component and Aggregate GDP Forecasts

This section provides an overview of the selection of forecasting regressions for total GDP, nominal GDP, the GDP deflator, and GDP elements – overall 22 variables. Each GDP component sub-section below describes the size of the component relative to total GDP, its correlation with GDP, and its relationship to the corresponding "special" indicator, if applicable.

The greater the size of a GDP component, the more important its forecast for projecting total GDP, which is the goal of this study. In this respect, the most important national account components are household consumption, employees’ compensation, and gross profit and mixed income. At the same time, obtaining accurate projections of other goods production value-added and consumption by non-commercial organizations serving households is of little importance for total GDP forecasting.

Since many individual monthly indicators from which principal components are extracted describe economic conditions in general and are not necessarily linked directly to specific national account variables, strong correlation between the variable and total GDP facilitates the forecasting of this variable (provided, of course, that the monthly indicators are properly selected to describe overall economic activity). Strong correlation with GDP may become especially important if the national account variable does not have a "special" indicator or if its dynamics substantially vary from the dynamics of the "special" indicator. The export variable is among the variables that are most difficult to forecast, partly because it is not strongly correlated with either total GDP or its “special” indicator. The volatility of a variable may complicate its forecasting. During the period under consideration, production-side GDP components were generally less volatile than expenditure-side and income side-components.

The focus in the discussion of individual regressions is on the absolute and comparative accuracy of out-of-sample forecasts obtained through the three methods described in Section 1.2 – one method for current-quarter forecasting and two methods for one-
quarter-ahead forecasting. Each component sub-section states the margin of error of forecasts produced by the three methods and indicates the degree of forecast accuracy as defined in Section 1.2. The margin of forecast error is measured as the difference between the official and forecasted indices of the variable.

Table 3.1.2.1. Russia: Shares of GDP Components in Total GDP, %

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>22.5</td>
<td>22.7</td>
<td>22.9</td>
<td>23.0</td>
<td>23.9</td>
<td>24.1</td>
<td>24.1</td>
<td>23.9</td>
<td>23.9</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>4.9</td>
<td>4.8</td>
<td>4.8</td>
<td>4.2</td>
<td>4.6</td>
<td>4.7</td>
<td>5.0</td>
<td>4.9</td>
<td>4.8</td>
</tr>
<tr>
<td>Agricultural value-added</td>
<td>7.0</td>
<td>6.0</td>
<td>5.6</td>
<td>5.6</td>
<td>5.5</td>
<td>5.9</td>
<td>6.2</td>
<td>6.1</td>
<td>6.5</td>
</tr>
<tr>
<td>Other goods production value-added</td>
<td>1.1</td>
<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
<td>0.9</td>
<td>1.0</td>
<td>0.9</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>18.5</td>
<td>19.6</td>
<td>20.3</td>
<td>20.0</td>
<td>18.5</td>
<td>18.8</td>
<td>18.6</td>
<td>19.2</td>
<td>19.9</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>8.0</td>
<td>7.9</td>
<td>7.7</td>
<td>7.8</td>
<td>8.1</td>
<td>7.8</td>
<td>7.8</td>
<td>7.9</td>
<td>8.0</td>
</tr>
<tr>
<td>Other market services value-added</td>
<td>16.9</td>
<td>17.2</td>
<td>17.3</td>
<td>17.8</td>
<td>17.5</td>
<td>16.7</td>
<td>16.6</td>
<td>16.5</td>
<td>15.8</td>
</tr>
<tr>
<td>Non-market services value-added</td>
<td>11.3</td>
<td>12.1</td>
<td>11.7</td>
<td>12.5</td>
<td>12.0</td>
<td>11.0</td>
<td>10.4</td>
<td>10.2</td>
<td>9.9</td>
</tr>
<tr>
<td>Net taxes on products and imports</td>
<td>10.1</td>
<td>9.0</td>
<td>8.9</td>
<td>8.6</td>
<td>9.5</td>
<td>10.3</td>
<td>10.6</td>
<td>10.6</td>
<td>10.5</td>
</tr>
<tr>
<td><strong>Expenditures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household consumption</td>
<td>49.5</td>
<td>48.9</td>
<td>50.6</td>
<td>51.6</td>
<td>47.1</td>
<td>45.9</td>
<td>47.9</td>
<td>49.6</td>
<td>49.7</td>
</tr>
<tr>
<td>Government consumption</td>
<td>20.2</td>
<td>21.6</td>
<td>20.8</td>
<td>22.2</td>
<td>21.5</td>
<td>19.9</td>
<td>18.8</td>
<td>18.4</td>
<td>17.6</td>
</tr>
<tr>
<td>Non-commercial organizations</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
<td>1.2</td>
<td>1.1</td>
<td>1.1</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Gross fixed investment</td>
<td>22.9</td>
<td>18.7</td>
<td>17.0</td>
<td>15.7</td>
<td>15.7</td>
<td>16.9</td>
<td>17.7</td>
<td>17.3</td>
<td>18.2</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>4.7</td>
<td>5.9</td>
<td>6.3</td>
<td>-2.2</td>
<td>-3.9</td>
<td>2.0</td>
<td>3.3</td>
<td>2.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>27.3</td>
<td>29.3</td>
<td>28.8</td>
<td>31.0</td>
<td>32.4</td>
<td>32.2</td>
<td>31.9</td>
<td>33.6</td>
<td>35.3</td>
</tr>
<tr>
<td>Imports of goods and services</td>
<td>20.7</td>
<td>21.7</td>
<td>21.5</td>
<td>18.8</td>
<td>14.6</td>
<td>17.6</td>
<td>19.9</td>
<td>21.8</td>
<td>23.9</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nom. employees' compensation</td>
<td>45.4</td>
<td>50.9</td>
<td>51.4</td>
<td>48.0</td>
<td>40.1</td>
<td>40.2</td>
<td>43.0</td>
<td>46.7</td>
<td>46.9</td>
</tr>
<tr>
<td>Nom. gross profit and mixed income</td>
<td>42.8</td>
<td>34.8</td>
<td>33.4</td>
<td>36.0</td>
<td>44.2</td>
<td>42.7</td>
<td>41.3</td>
<td>39.2</td>
<td>39.6</td>
</tr>
<tr>
<td>Nom. net taxes on prod'n and imp's</td>
<td>11.9</td>
<td>14.2</td>
<td>15.2</td>
<td>16.0</td>
<td>15.7</td>
<td>17.1</td>
<td>15.7</td>
<td>14.1</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Notes: The shares of the production-side and expenditure-side components are calculated with respect to real production-side GDP in 2003 prices. The income-side figures are nominal. Data for 2004 are not provided in the table since the historical sample ends in the third quarter of 2004, and the shares for the first three quarters would not be comparable with the annual shares because of seasonality.
Table 3.1.2.2. Russian National Account Indices, Official Figures and Current-Quarter Forecasts Generated by Complex Regressions, %

<table>
<thead>
<tr>
<th></th>
<th>Regression</th>
<th>Official index</th>
<th>Forecasted index</th>
<th>Margin of error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2004Q2</td>
<td>2004Q3</td>
<td>2004Q2</td>
<td>2004Q3</td>
</tr>
<tr>
<td><strong>GDP - direct</strong></td>
<td>1.2</td>
<td>7.51</td>
<td>7.11</td>
<td>7.53</td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>2.1</td>
<td>7.23</td>
<td>5.18</td>
<td>7.37</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>4.1</td>
<td>14.66</td>
<td>6.72</td>
<td>14.60</td>
</tr>
<tr>
<td>Agricultural value-added</td>
<td>4.1</td>
<td>0.00</td>
<td>4.87</td>
<td>-0.01</td>
</tr>
<tr>
<td>Other goods prod'n value-added</td>
<td>22.1</td>
<td>6.09</td>
<td>6.09</td>
<td>6.33</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>5.1</td>
<td>10.29</td>
<td>10.42</td>
<td>10.07</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>6.1</td>
<td>10.84</td>
<td>10.13</td>
<td>10.37</td>
</tr>
<tr>
<td>Other market services value-added</td>
<td>7.1</td>
<td>4.09</td>
<td>6.77</td>
<td>3.97</td>
</tr>
<tr>
<td>Non-market services value-added</td>
<td>8.1</td>
<td>2.37</td>
<td>2.49</td>
<td>2.58</td>
</tr>
<tr>
<td>Net taxes on prod's and imp's</td>
<td>9.1</td>
<td>5.15</td>
<td>9.38</td>
<td>5.81</td>
</tr>
<tr>
<td><strong>GDP - production side</strong></td>
<td>7.51</td>
<td>7.11</td>
<td>7.53</td>
<td>7.10</td>
</tr>
<tr>
<td>Household consumption</td>
<td>10.1</td>
<td>10.80</td>
<td>12.08</td>
<td>10.91</td>
</tr>
<tr>
<td>Government consumption</td>
<td>11.1</td>
<td>2.40</td>
<td>2.62</td>
<td>2.52</td>
</tr>
<tr>
<td>Non-commercial organizations</td>
<td>12.1</td>
<td>0.00</td>
<td>-1.94</td>
<td>0.13</td>
</tr>
<tr>
<td>Gross fixed investment</td>
<td>13.1</td>
<td>11.67</td>
<td>10.37</td>
<td>11.93</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>64.46</td>
<td>19.50</td>
<td>71.62</td>
<td>20.63</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>15.1</td>
<td>13.28</td>
<td>12.62</td>
<td>14.50</td>
</tr>
<tr>
<td>Imports of goods and services</td>
<td>16.1</td>
<td>24.17</td>
<td>24.69</td>
<td>25.17</td>
</tr>
<tr>
<td><strong>GDP - expenditure side</strong></td>
<td>7.55</td>
<td>7.36</td>
<td>8.08</td>
<td>7.12</td>
</tr>
<tr>
<td>Nom. employees' compensation</td>
<td>25.95</td>
<td>24.60</td>
<td>25.86</td>
<td>24.67</td>
</tr>
<tr>
<td>Nom. gross profit and mixed income</td>
<td>19.1</td>
<td>31.28</td>
<td>31.11</td>
<td>32.47</td>
</tr>
<tr>
<td>Nom. net taxes and prod'n and imp's</td>
<td>20.1</td>
<td>19.37</td>
<td>34.70</td>
<td>20.78</td>
</tr>
<tr>
<td>Nominal GDP - income side</td>
<td>26.92</td>
<td>28.66</td>
<td>27.53</td>
<td>29.23</td>
</tr>
<tr>
<td>Nominal GDP - direct</td>
<td>17.1</td>
<td>26.92</td>
<td>28.66</td>
<td>27.61</td>
</tr>
<tr>
<td>Nominal GDP - average</td>
<td>26.92</td>
<td>28.66</td>
<td>27.57</td>
<td>28.85</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>21.1</td>
<td>18.06</td>
<td>20.12</td>
<td>18.19</td>
</tr>
<tr>
<td><strong>GDP - nominal approach</strong></td>
<td>7.51</td>
<td>7.11</td>
<td>7.94</td>
<td>7.57</td>
</tr>
<tr>
<td><strong>GDP - average</strong></td>
<td>7.52</td>
<td>7.17</td>
<td>7.77</td>
<td>7.23</td>
</tr>
</tbody>
</table>
As we can see from Table 3.1.2.2, most of the selected complex regressions – containing principal components, “special” indicators, and other right-hand-side variables as discussed in Chapter 1 – produce very accurate current-quarter forecasts for both the second and the third quarters of 2004. The only inaccurate current-quarter forecast is the second-quarter forecast of change in inventories. The margin of error of is 7.1 percentage points. This substantial inaccuracy is a result of the fact that this variable is forecasted not directly, but through the projections of fixed investment and the ratio of total investment to fixed investment. The forecasts of the two latter variables are accurate. The derived forecast of change in inventories is inaccurate, mostly because of the minor share of this GDP component in the second quarter.

Of the four total GDP forecasting approaches that were described in Section 1.1, the most accurate current-quarter forecasts are produced through the direct approach and the production-side approach. The margin of error of all of the total GDP forecasts is within the "very accurate" range with one exception. The margin of error of total GDP estimated as the sum of the expenditure-side components slightly exceeds one half percentage point for the second quarter of 2004, falling within the "accurate" range, as the forecast errors of all the expenditure-side components contributed to the overestimation of total GDP. The fact that expenditure-side GDP forecasts may tend to be less accurate than the forecasts obtained through other approaches is to some extent due to the fact that the expenditure-side components include exports and change in inventories – variables that are relatively difficult to forecast.

The next-quarter out-of-sample forecasts are generated for the third quarter of 2004 using two methods. The first (two-step) method uses the same regressions that are applied for current-quarter forecasting, but the contemporaneous explanatory variables are themselves projected one quarter ahead. The second (one-step) method is based on regressions that do not contain any contemporaneous explanatory variables. The first method is not applied for four variables. For construction value-added and employees’ compensation, the current-quarter model is not built because the recent official indices of

31 Residual variables are generally difficult to forecast.
these variables are almost identical to the official indices of their respective "special" indicators. For non-market services value-added and nominal taxes on production and imports, contemporaneous explanatory variables are not included in the selected regressions since they do improve current-quarter forecasts. In the calculation of total GDP that aggregates the estimates generated by the first method, the forecasted growth rates of these four variables are assumed to be the same as the respective growth rates obtained through the second method.

We can see from Table 3.1.2.3 that almost all of the next-quarter forecasts of the individual national account variables are either very accurate or just accurate. The only exception is the two-step forecast of change in inventories, which is inaccurate. As in the case of the current-quarter forecasting of this variable, the inaccuracy arises mainly from the fact that change in inventories is not forecasted directly.

The aggregate GDP forecasts are mostly very accurate. One exception is the two-step expenditure-side GDP forecast, which is just accurate. The margin of error of the two-step nominal approach GDP forecast equals exactly one-half percentage point, which is the border value between the “very accurate” and “accurate” ranges. Table 3.1.2.3 shows that for individual national account components, the two-step next-quarter forecasts are almost always more accurate than one-step next-quarter forecasts.

As is the case of current-quarter forecasts, the total GDP two-step next-quarter forecasts are more accurate when obtained through the direct and production-side approaches. The one-step next-quarter total GDP forecasts are more accurate when generated through the production-side and expenditure-side approaches. However, the difference in the accuracy of one-step next-quarter GDP forecasts obtained through the four methods is negligible.

One of the absolute criteria of forecast accuracy is the location of the official data within the plus/minus one standard deviation confidence interval estimated on the basis of an out-of-sample forecast. All of the complex regressions selected for the forecasting of
national account variables in this section satisfy this criterion. Therefore, it is not described in the individual component sub-sections below.

Table 3.1.2.3. Russian National Account Indices, Official and One-Quarter-Ahead Forecasts Obtained through the Two-Step and One-Step Methods, %

<table>
<thead>
<tr>
<th>Official index</th>
<th>Regression Method 1</th>
<th>Regression Method 2</th>
<th>Forecasted index Method 1</th>
<th>Forecasted index Method 2</th>
<th>Margin of error Method 1</th>
<th>Margin of error Method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GDP - direct</strong></td>
<td>7.11</td>
<td>1.2</td>
<td>1.11</td>
<td>7.42</td>
<td>7.23</td>
<td>-0.31</td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>5.18</td>
<td>2.1</td>
<td>2.8</td>
<td>5.99</td>
<td>5.28</td>
<td>-0.81</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>6.72</td>
<td>3.2</td>
<td>3.2</td>
<td>7.86</td>
<td>7.86</td>
<td>-1.14</td>
</tr>
<tr>
<td>Agricultural value-added</td>
<td>4.87</td>
<td>4.1</td>
<td>4.8</td>
<td>6.06</td>
<td>4.81</td>
<td>-1.19</td>
</tr>
<tr>
<td>Other goods prod'n value-added</td>
<td>6.09</td>
<td>22.1</td>
<td>22.9</td>
<td>4.83</td>
<td>6.21</td>
<td>1.26</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>10.42</td>
<td>5.1</td>
<td>5.8</td>
<td>10.95</td>
<td>10.39</td>
<td>-0.53</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>10.13</td>
<td>6.1</td>
<td>6.11</td>
<td>10.55</td>
<td>10.26</td>
<td>-0.42</td>
</tr>
<tr>
<td>Other market services value-added</td>
<td>6.77</td>
<td>7.1</td>
<td>7.8</td>
<td>5.28</td>
<td>5.32</td>
<td>1.49</td>
</tr>
<tr>
<td>Non-market services value-added</td>
<td>2.49</td>
<td>8.1</td>
<td>8.1</td>
<td>2.48</td>
<td>2.48</td>
<td>0.01</td>
</tr>
<tr>
<td>Net taxes on prod's and imp's</td>
<td>9.38</td>
<td>9.1</td>
<td>9.9</td>
<td>8.56</td>
<td>9.31</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>GDP - production side</strong></td>
<td>7.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household consumption</td>
<td>12.08</td>
<td>10.1</td>
<td>10.9</td>
<td>11.60</td>
<td>11.65</td>
<td>0.48</td>
</tr>
<tr>
<td>Government consumption</td>
<td>2.62</td>
<td>11.1</td>
<td>11.9</td>
<td>2.76</td>
<td>2.43</td>
<td>-0.15</td>
</tr>
<tr>
<td>Non-commercial organizations</td>
<td>-1.94</td>
<td>12.1</td>
<td>12.9</td>
<td>-0.88</td>
<td>-2.23</td>
<td>-1.06</td>
</tr>
<tr>
<td>Gross fixed investment</td>
<td>10.37</td>
<td>13.1</td>
<td>13.7</td>
<td>11.38</td>
<td>10.68</td>
<td>-1.01</td>
</tr>
<tr>
<td>Change in inventories</td>
<td>19.50</td>
<td></td>
<td></td>
<td>17.07</td>
<td>18.82</td>
<td>2.43</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>12.62</td>
<td>15.1</td>
<td>15.7</td>
<td>11.26</td>
<td>13.64</td>
<td>1.36</td>
</tr>
<tr>
<td>Imports of goods and services</td>
<td>24.69</td>
<td>16.1</td>
<td>16.8</td>
<td>24.42</td>
<td>25.32</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>GDP - expenditure side</strong></td>
<td>7.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nom. employees' compensation</td>
<td>24.60</td>
<td>18.1</td>
<td>18.1</td>
<td>24.76</td>
<td>24.76</td>
<td>-0.16</td>
</tr>
<tr>
<td>Nom. gross profit and mixed income</td>
<td>31.11</td>
<td>19.1</td>
<td>19.9</td>
<td>30.30</td>
<td>30.01</td>
<td>0.81</td>
</tr>
<tr>
<td>Nom. net taxes and prod'n and imp's</td>
<td>34.70</td>
<td>20.1</td>
<td>20.1</td>
<td>35.84</td>
<td>35.84</td>
<td>-1.14</td>
</tr>
<tr>
<td>Nominal GDP - income side</td>
<td>28.66</td>
<td></td>
<td></td>
<td>28.54</td>
<td>28.42</td>
<td>0.12</td>
</tr>
<tr>
<td>Nominal GDP - direct</td>
<td>28.66</td>
<td>17.1</td>
<td>17.9</td>
<td>27.83</td>
<td>28.85</td>
<td>0.83</td>
</tr>
<tr>
<td>Nominal GDP - average</td>
<td>28.66</td>
<td></td>
<td></td>
<td>28.19</td>
<td>28.63</td>
<td>0.47</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>20.12</td>
<td>21.1</td>
<td>21.8</td>
<td>20.24</td>
<td>20.21</td>
<td>-0.12</td>
</tr>
<tr>
<td><strong>GDP - nominal approach</strong></td>
<td>7.11</td>
<td></td>
<td></td>
<td>6.61</td>
<td>7.01</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>GDP - average</strong></td>
<td>7.17</td>
<td></td>
<td></td>
<td>7.02</td>
<td>7.17</td>
<td>0.15</td>
</tr>
</tbody>
</table>
One method of relative accuracy testing for current-quarter forecasting is the comparison of the forecast margin of error with the discrepancy between the official index of the national account variable and the official index of its "special" indicator, when applicable. It is found that in two cases – for construction value-added and for nominal employees' compensation – the discrepancy between the official national account and "special" indicator indices is so small that it can be assumed that these indices equal each other. In these two cases, a current quarter model is not needed. The industrial value-added index is also very close to the index of its "special" indicator. Nevertheless, a selected regression for industrial value-added produces, on balance, i.e., for the two quarters, more accurate forecasts than the estimates that would be based on the assumption that the industrial value-added indices equal the indices of the "special" indicator. For the rest of the variables, the forecast margin of error is less than the discrepancy between the official index of the national account variable and the official index of its "special" indicator for both the second and the third quarters of 2004. Except for industrial value-added, construction value-added, and employees' compensation, this issue is not further discussed below.

Another way of testing relative forecast accuracy is the comparison of the out-of-sample forecasts produced by complex regressions containing right-hand-side variables as described in Section 1.1 with the forecasts generated by single-variable regressions. For almost all of the national account variables, the former forecasts are more accurate than the latter for both the second and the third quarters of 2004, although, in several cases, the difference in forecast accuracy is only slight. On a few occasions, for one quarter, the forecast provided by a simple regression is more accurate than the forecast obtained through a complex regression. However, even in such cases, on balance, for the two quarters, the former forecasts are less accurate than the latter. The degree of accuracy of single-variable regression forecasts is described below, but, unless otherwise indicated, it should be assumed that the complex regression forecasts are more accurate than the simple regression forecasts. Also, in most cases the adjusted R-squared for a selected

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32 It is possible that at the end of the period under consideration, this discrepancy resulted from a rounding error for these indicators.
complex regression is greater than the adjusted R-squared for the selected single-variable regressions.

The single-variable regressions themselves underwent a selection process in order to improve their out-of-sample forecasting power. First of all, regressions with the same ARMA terms and lagged dependent variables as those included in the complex regressions were considered. Then, different combinations of ARMA terms and lagged dependent variables were tested to determine whether they would result in an improved forecast.

Special attention is paid to the usefulness of crisis dummy variables, primarily in the improvement of out-of-sample forecasts. For most regressions in this section, the Chow breakpoint test cannot be applied without the omission of some of the right-hand-side variables because of the shortness of the pre-crisis sub-sample, a large number of these variables, and the adjustment of the sample due to the use of lagged variables and AR terms. This variable omission, however, often leads to a regression specification with a substantially lower adjusted R-squared and completely different out-of-sample forecasts. Thus, the Chow test is, generally, not very useful. When the Chow test can be applied without variable omission, it usually signals the presence of a structural break resulting from the crisis. The comparison of out-of-sample forecasts shows that the introduction of crisis dummy variables improves forecasts for most of the complex and single-variable regressions.

The results of the reduction of the historical sample to the post-crisis period are usually reported only if this reduction leads to out-of-sample forecast improvement. This sample reduction is found helpful only on a few occasions. One problem is related to the fact that although the number of observations in the post-crisis sub-sample is much greater than the number of observations in the pre-crisis sub-sample, it is still not high enough to accommodate a substantial number of right-hand-side variables. The reduction of the sample to the post-crisis period is found useful in complex regressions for construction value-added and for the ratio of total investment to fixed investment. It also improves the
forecasting properties of several regressions projecting principal components as well as some single-variable regressions. The first two years of observations are also disregarded for fixed investment. However, this is done in order to eliminate the period of especially high discrepancies between the index of the forecasted variable and the index of its "special" indicator.

Residual tests are mentioned below only when there appears to be a problem.

For each national account variable, Appendix A contains the estimation outputs generated by complex and simple regressions as well as summary tables that include the official and forecasted indices of the variable and the official indices of its "special" indicator. The summary tables also indicate whether crisis dummy variables are used and whether the regression is estimated on the basis of the full sample or a reduced sample.

**GDP.** The selection of monthly indicators from which the principal components were extracted for total real GDP (DLGDP) was described in Section 1.1. Overall, 20 indicators were selected. Regression 1.1, which includes the first four principal components jointly explaining 52.7% of the variance in the original indicators, provides a good fit of the data judging by an adjusted R-squared of 0.883. After the reduction of the sample by two quarters and the re-estimation of regression 1.1 based on the reduced sample, the values of GDP were forecasted using the official values of monthly indicators for the out-of-sample period – the second and the third quarters of 2004. The discrepancy between the official and forecasted GDP index – the forecast margin of error – equaled 0.31 percentage point for the second quarter and 0.23 percentage point for the third quarter, i.e., the forecasts were within the “very accurate” range as defined in Section 1.2.

\[
DLGDP = C(1) + C(2) \cdot PC1 + C(3) \cdot PC2 + C(4) \cdot PC3 + C(5) \cdot PC4 + [MA(4)=C(6)] \quad (1.1)
\]

In this section, all variables are in the form of the difference of logarithms unless otherwise indicated.
The Chow breakpoint test indicates the presence of a structural break between the pre-crisis and post-crisis sub-samples. To take into account the structural break, various dummy variables were introduced. The best choice is the introduction of the slope dummy variable for PC1, DUMMYPC1 (see Regression 1.2). The adjusted R-squared for Regression 1.2 was 0.888, slightly higher than for Regression 1.1. The margin of error for the current-quarter out-of-sample forecasts was also better than for Regression 1.1 – 0.03 and 0.05 for the second and the third quarters, respectively. Thus, Regression 1.2 is preferred to Regression 1.1.

\[
DLGDP = C(1) + C(2)*PC1 + C(3)*DUMMYPC1 + C(4)*PC2 + C(5)*PC3 + C(6)*PC4 + [MA(4)=C(7)] \tag{1.2}
\]

It is interesting that the Regression 1.2 margin of error for both quarters was less than the discrepancy between the GDP index calculated using the official pre-February-2005-revision data and the index calculated from the official revised data (that were used to estimate Regression 1.2). I did not conduct systematic testing of whether the model estimates were closer to the revised data than were the preliminary data. Nevertheless, this example shows that this model may be applied for improving preliminary national account statistics.

As discussed in Section 1.1, the choice between alternative monthly indicators was often based on the accuracy of the out-of-sample forecasts that the respective sets of monthly indicators produced. Below is an example of such a forecast accuracy comparison. Regression 1.3 was estimated on the basis of principal components calculated from the set of monthly indicators in which construction (one of the monthly indicators applied to extract the principal components for Regression 1.2) was replaced with fixed investment (measured using the “monthly” methodology). The Regression 1.3 forecast margin of error was 0.35 percentage point for the second quarter and 0.09 percentage point for the third quarter, within the “very accurate” range, but greater than the Regression 1.2 margin of error. In addition, the adjusted R-squared was lower for Regression 1.3 than for Regression 1.2.
Regression 1.1 was also estimated on the basis of the post-crisis sample (see Regression 1.13). 34 In this case, the margin of forecast error significantly rises, although the forecasts stay within the “accurate” range.

Since Regression 1.2 includes a slope dummy variable, two sets of partial derivatives of GDP with respect to the monthly indicators were calculated: one for the period before the crisis and the other for the post-crisis period (see Tables 1.3 and 1.4 in Appendix A). With one exception, the signs of the partial derivatives are the same for both periods.

Most of the partial derivatives of GDP with respect to monthly indicators have the signs that may be considered normal. Two partial derivatives – with respect to the ratio of consumer prices to industrial producer prices and with respect to the ratio of government defense spending to consolidated government budget spending – may have any sign. It is difficult to say a priori how these indicators will affect GDP.

The signs of two partial derivatives – with respect to the exchange rate and with respect to the merchandise exports-to-imports ratio (for the post-crisis period) – may seem counterintuitive. The negative sign of the partial derivative with respect to the exchange rate means that the ruble’s real depreciation against the dollar is accompanied by a decline in GDP, which contradicts the generally accepted hypothesis that depreciation helps the Russian economy. One possible explanation of this sign could be the wealth effect. Since Russians tend to measure their wealth in dollars, depreciation decreases perceived wealth, which results in a drop in spending and GDP.

The negative sign of the partial derivative with respect to the exchange rate is confirmed by the negative correlation between the exchange rate and GDP indices (see Table 3.1.1.1) and through a single-variable regression. A regression of GDP on the exchange

34 Although the DW test statistic for Regression 1.13 equals 2.83, the LM test shows that the null hypothesis of no serial correlation in the residuals up to lag order four cannot be rejected at a 10% significance level.
rate (1.6) shows that the ruble’s depreciation has a negative contemporaneous impact on GDP. However, at the same time, it demonstrates that the Russian economy does benefit from depreciation, only with a two-quarter lag. Since the positive lagged impact is stronger than the negative contemporaneous impact, the total effect is positive, which supports the conventional view. The correlation between the GDP index and the exchange rate index with a two-quarter lag is also positive.

The partial derivative of the exports-to-imports ratio is very close to zero. It is marginally positive for the pre-crisis period and marginally negative for the period following the crisis. The negative sign appears counterintuitive because exports and imports enter the GDP final expenditure identity, respectively, with the positive sign and with the negative sign. However, a regression of GDP on merchandise imports (1.8) and the correlation between the import and GDP indices also show that the contemporaneous impact of imports on GDP was positive. This can be probably explained by the fact that imports of some production materials and unfinished goods can lead to greater output. At the same time, Regression 1.8 demonstrates that with a two-quarter lag, imports had a strong negative effect on GDP before the crisis. After the crisis, it became much milder. Nevertheless, even after the crisis the negative lagged impact exceeded the positive contemporaneous impact.

None of the single-variable regressions provides a very accurate out-of-sample forecast of GDP for both the second and the third quarters of 2004, but one of them – with steel production in physical units (1.7) – has a higher adjusted R-squared than Regression 1.2. Three regressions – with the exchange rate (1.6), steel production, and merchandise imports (1.8) – generate a very accurate forecast for one quarter, but the other quarter forecast is just accurate. The regressions with the world oil price (1.4) and industrial production (1.5) generate forecasts that are accurate in one quarter, but either border-line accurate or inaccurate in the other.\footnote{The regression with the oil price overestimates GDP growth by 1 and 2.2 percentage points in the second and the third quarters of 2004, respectively. The growth rates}

\footnote{The regression with the oil price overestimates GDP growth by 1 and 2.2 percentage points in the second and the third quarters of 2004, respectively. The growth rates}
includes the money supply (1.10) is border-line accurate for one quarter and inaccurate for the other. Finally, the forecasts generated with the electricity output regression (1.9) are inaccurate for both quarters.

Regression 1.2 was also used for one-quarter-ahead out-of-sample forecasting. After the reduction of the sample by one quarter, the four principal components were projected for the third quarter of 2004. The resulting GDP forecast for the third quarter based on the projected principal component values was very accurate with the margin of error of 0.31 percentage point.

Figure 3.1.2.1. First Principal Component (PC1) for Russian GDP

As can be seen from Figure 3.1.2.1, the first principal component, PC1, was extremely low in the third quarter of 1998, the crisis quarter, and extremely high a year later, in the third quarter of 1999. The PC1 values in these two quarters are, clearly, outliers.

obtained through this regression are close to what the CMASF believes they should have been given the actual oil price increase.
Therefore, two dummy variables were introduced: DUMMY8 = 1 in the third quarter of 1998 and 0 otherwise, and DUMMY9 = 1 in the third quarter of 1999 and 0 otherwise. Without these dummies, the Jarque-Bera statistic indicates that the residuals are not normally distributed. The other three principal components did not have this pattern. It was found, however, that they are more accurately forecasted if their regressions are estimated on the basis of the post-crisis sample only.

Regression 1.11, which includes only lagged independent variables, provides a very accurate one-quarter-ahead out-of-sample GDP forecast for the third quarter of 2004 with the margin of error of 0.12 percentage point. This regression does not include a crisis dummy variable. An introduction of a crisis dummy may lead to a slight increase in the adjusted R-squared, but does not lead to a forecast margin of error reduction (see Regression 1.12, for example).

*Industrial value-added.* Industry is the largest Russian sector, which in 2003 accounted for 24.0% of GDP. Compared to 1995, its share increased by 1.5 percentage points, more significantly than the share of any other sector. The importance of this sector is determined not only by its large share in the economy. The core of Russian industry, the fuel and energy complex, has generally been considered the engine of overall Russian economic growth. Although industry was expanding faster than GDP, the correlation between the GDP index and the industrial value-added index, 0.93, was higher than the correlation between the GDP index and the index of any other GDP component.

The current-quarter out-of-sample forecasting of Russian industrial value-added is relatively easy because quarterly industrial value-added grows at roughly the same rate as quarterly industrial production. The average absolute value of the difference between the indices of these two indicators was 0.6 percentage point, but the most significant discrepancies, exceeding two percentage points, were observed at the beginning of the historical sample. In 2004, the discrepancy did not exceed 0.4 percentage point and was,

36 Although the sets of monthly indicators vary by GDP element, this pattern was common for PC1's extracted from other sets.
possibly, a result of a rounding error. Therefore, knowledge of official industrial production data may be sufficient to estimate the industrial value-added index with the margin of error within the “very accurate” range.

Figure 3.1.2.2. Russia: Industrial Value-Added and Industrial Production, Quarterly Year-Over-Year Indices

Nevertheless, I attempted to find econometric regularities that can be used to produce better current-quarter forecasts of the industrial value-added indices than those obtained through the direct application of the official industrial production indices. The out-of-sample forecasts obtained through the regression of industrial value-added (DLINDVA) on industrial production (DLIND) (2.2) are, on balance, slightly closer to the official industrial value-added indices than are the official industrial production indices. An introduction of a principal component (Regression 2.1) provides, on balance, a further forecast improvement. The margin of error of the forecast obtained through Regression
2.1 does not exceed 0.14 point. The adjusted R-squared also improves if the principal component is introduced.

\[ DLINDVA = C(1) + C(2)DLIND + C(3)PC2 + \\
[\text{AR}(1)=C(4),\text{AR}(2)=C(5),\text{AR}(4)=C(6),\text{MA}(4)=C(7)] \]  

(2.1)

The introduction of crisis dummy variables does not help improve current-quarter out-of-sample forecasts compared to regression 2.1. One example is Regression 2.3, although the forecasts that it generates are also very accurate. Somewhat worse results are obtained when only the post-crisis period is used for regression estimation. The forecast provided by Regression 2.10 is very accurate for one quarter, but just accurate for the other.  

The out-of-sample forecasts obtained through single-variable regressions, not counting the regression based on industrial production, are almost always inaccurate for at least one quarter of the two. One exception is the regression with the money supply (2.7) that generates a very accurate forecast for one quarter and an accurate forecast for the other. The forecast made with the use of the regression with freight transportation (2.6) is very accurate for one quarter. The regression with the world oil price (2.4) overestimates the rise in industrial value-added even more significantly than Regression 1.4 overestimates GDP growth.

Regression 2.1 generates an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 1.33 percentage points when the contemporaneous explanatory variables are themselves forecasted. The ARMA regressions for both contemporaneous explanatory variables include crisis dummies. The Regression 2.1 margin of error.

\[ \text{The specification of Regression 2.10 is different from the Regression 2.1 specification. Unlike Regression 2.1, Regression 2.10 does not include autoregressive terms since their coefficients become statistically insignificant when the sample is reduced to the post-crisis period. This problem is common for other Russian national account components, as the post-crisis period may be too short to accommodate a large number of right-hand-side variables, especially when the introduction of these variables requires sample adjustment.} \]
improves to 1.19 percentage points, if one of these two variables is forecasted on the basis of the post-crisis sample.

Regression 2.8, which includes only lagged explanatory variables, produces a very accurate one-quarter-ahead out-of-sample forecast of industrial value-added with the margin of error of 0.10 percentage point. The removal of the principal components from Regression 2.8 (see Regression 2.9) results in a significant decline in the adjusted R-squared and an increase in the forecast margin of error, which, however, remains within the “accurate” range. Regression 2.8 includes a crisis dummy variable. When it is removed, the White test indicates the presence of heteroscedasticity in the residuals.

Construction value-added. Construction is a relatively small sector, with value-added just slightly exceeding value-added in agriculture. The share of construction value-added in GDP dropped in the two years before the crisis, but then stabilized and started to grow. In 2003, it stood at 6.5%, still one half percentage point below what it was in 1997. Construction growth was highly correlated with overall economic growth – the correlation coefficient between the GDP and construction value-added indices was 0.89.

For most of the historical period, the construction value-added indices were just marginally different from the construction activity indices. This discrepancy was even smaller than the difference between the industrial value-added and industrial production indices. In 2003-2004, the discrepancy was about 0.1 percentage point, which was probably due to a rounding error. This difference was higher, ranging from 1 to 2.3 percentage points, in 1999 and 2001. It is possible that methodological and/or data collection changes related to one of the two variables in those years were not matched by changes in the other. It appears that for current-quarter out-of-sample forecasting, the availability of the monthly construction activity figures for a full quarter should be sufficient for the exact estimation of the construction value-added index in that quarter. Therefore, for this variable, only a one-quarter-ahead forecast through a regression with lagged independent variables was estimated.
The problem with one-quarter-ahead forecasting for construction using only lagged independent variables is that, apparently, as many Russian and foreign economists note, there was a sharp deterioration in investor confidence in the third quarter of 2004 because of the YUKOS case and instability in the banking sector. It is generally believed that this led to a sharp slowdown in year-over-year construction growth – to 6.7% in the third quarter of 2004 from between 13.5% and 14.7% in the first quarter of 2003 – the second quarter of 2004, according to the official figures. Full-sample construction value-added (DLCONSTRVA) regressions (for example, Regression 3.1) that include only lagged dependent variables do not capture the summer 2004 drop in investor confidence and do not project a sharp slowdown in construction activity that occurred in the third quarter.

**Figure 3.1.2.3. Russia: Construction Value-Added and Construction, Quarterly Year-Over-Year Indices**

The residual obtained from Regression 3.1 for that quarter is the highest in absolute terms in the entire historical sample. As we can see from Figure 3.1 in Appendix A, the actual
(official) figure is much lower than the fitted figure. At the same time, Regression 3.1 explained quite well many troughs and peaks in the dynamics of construction value-added, including the 1998 crisis and the recovery that followed. The out-of-sample forecast of the construction value-added index estimated on the basis of Regression 3.1 for the second quarter of 2004 is close to the official index: the difference between the official and forecasted indices is 1.2 percentage points.

The deterioration of the investment climate in mid-2004 can, apparently, be captured by a regression estimated for the post-crisis sample only. Regression 3.2 has the same right-hand-side variables as Regression 3.1 except for the two that were removed because their coefficients became statistically insignificant. Estimated for the post-crisis sample, Regression 3.2 predicts 14.5% construction value-added growth in the second quarter of 2004 (which is closer to the official figure than the forecast obtained from Regression 3.1) and growth slowdown to 7.9% in the third quarter. Introducing crisis dummies in Regression 3.1, instead of reducing the full sample to the post-crisis period, does not help significantly in predicting the slowdown in third quarter of 2004.

\[
DLCONSTRVA = C(1) + C(2) \times PC1(-1) + C(3) \times PC6(-1) + C(4) \times PC1(-3) + [AR(1)=C(5),AR(3)=C(6),MA(4)]=C(7)\]  

(3.2)

Agricultural Value-Added. Not counting other goods production, agriculture is the smallest of the production-side sectors considered in this study. Its share in GDP was very stable in 1995-2003. In 2003, it accounted for 4.8% of GDP, 0.1 percentage point less than in 1995. Although quarterly agricultural value-added followed its own, highly seasonal pattern, its growth was substantially correlated with overall economic growth – the correlation coefficient between the indices of these two variables was 0.73. Like most of the economy, agriculture suffered in 1998. In fact, agricultural value-added declined more than value-added in any other sector that year.

The logical candidate for a “special” indicator is agricultural production. The average absolute value of the difference between the agricultural value-added and agricultural
production indices was not small, equaling 4.7 percentage points for the overall historical sample. This was largely due to the unusually large, double-digit discrepancies in 1999. Later, the two indices converged, and in 2003-2004, the average absolute value of the difference was 2.9 percentage points. A peculiar feature of Russian agriculture is that beginning in the first quarter of 1999, agricultural value-added growth outperformed agricultural production growth, with the exception of one quarter. The correlation coefficient between the indices of the two variables was 0.83; i.e., although high, this correlation coefficient was less than those between the indices of the two previously considered sectoral national account variables, on the one hand, and the indices of their respective “special” indicators, on the other hand.

The current-quarter out-of-sample forecast of agriculture value-added (DLAGRVA) based on the regression with agricultural production (DLAGR) as the single independent variable (4.3) is very accurate for one quarter and just accurate for the other. However, the introduction of principal components (Regression 4.1) reduces the margin of error substantially, to less than 0.05 percentage point. Regression 4.1 also provides better out-of-sample forecasts than Regression 4.2, which does not contain any crisis dummies, although the projections obtained from Regression 4.2 are accurate. Also, Regression 4.1 fits the data better than both Regressions 4.2 and 4.3, as measured by the adjusted R-squared.

\[
\text{DLAGRVA} = C(1) + C(2)\times\text{DLAGR} + C(3)\times\text{DLAGR}(-2) + C(4)\times\text{DUMMYDLAGR}(-2) + C(5)\times\text{PC5} + C(6)\times\text{DUMMYPC8} + [\text{AR}(1)=C(7),\text{AR}(2)=C(8),\text{MA}(4)=C(9)]
\] (4.1)

Out-of-sample forecasts generated by most of the single-variable regressions, not counting the regression with agricultural production, are inaccurate. The only exception is the regression with M2 (4.7), which produces very accurate out-of-sample forecasts for both quarters.
Regression 4.1 provides an accurate one-quarter-ahead out-of-sample forecast when contemporaneous independent variables are themselves forecasted through ARMA equations. When the forecasts of all three contemporaneous independent variables from Regression 4.1 are estimated on the basis of the full sample (with crisis dummy variables in two cases), the Regression 4.1 forecast margin of error for the third quarter of 2004 is 1.23 percentage points. The forecasts of two of the three contemporaneous independent variables improve when generated on the basis of the post-crisis sample. However, the Regression 4.1 forecast margin of error decreases negligibly – to 1.19 percentage points.

*Figure 3.1.2.4. Russia: Agricultural Value-Added and Agricultural Production, Quarterly Year-Over-Year Indices*

The one-quarter-ahead out-of-sample forecast of agricultural value-added estimated using Regression 4.8, which contains only lagged independent variables, is very accurate – the margin of error is 0.05 percentage point. The forecast becomes inaccurate and the
adjusted R-squared significantly declines if the crisis dummies or principal components are dropped (see Regressions 4.9 and 4.10, respectively).

*Other Goods Production Value-Added.* This is the smallest national account category considered in this study. In 2003, it accounted for 0.8% of GDP, down from 1.1% in 1995. The correlation between the other goods production value-added index and the GDP index was 0.51, the lowest of the correlations between any of the goods production value-added indices and the GDP index. This is the only sector in goods production for which it is impossible to identify a "special" indicator.

*Figure 3.1.2.5. Russia: Other Goods Production Value-Added, Quarterly Year-Over-Year Indices*

Regression 22.1 of other goods production value-added (DLOGVA) on principal components generates a very accurate current-quarter out-of-sample forecast for the second quarter of 2004 and an accurate forecast for the third quarter. The higher margin of error is 0.61. An introduction of a crisis dummy variable may increase the adjusted R-
squared, but also results in less accurate out-of-sample forecasts. One example is Regression 22.2. Nevertheless, the forecasts generated by Regression 22.2 are accurate.

\[
DLOGVA = C(1) + C(2)DLOGVA(-3) + C(3)DLOGVA(-4) + C(4)PC1 + 
C(5)PC1(-1) + C(6)PC11(-1) + C(7)PC13(-2) + [MA(4)=C(8)] \tag{22.1}
\]

Of the single-variable regressions, four regressions – with the Brent crude oil spot price (22.3), industrial production (22.4), retail sales (22.6), and freight transportation (22.7) – generate current-quarter out-of-sample forecasts that are accurate for one quarter and border-line accurate or inaccurate for the other. One regression – with the real exchange rate (22.5) – produces border-line accurate forecasts for both quarters.

Regression 22.1 generates an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 1.26 percentage points when the contemporaneous principal component is itself projected. Regression 22.10 applied to generate this projection includes a crisis dummy variable.

Regression 22.9, which includes only lagged principal components, produces a very accurate one-quarter-ahead out-of-sample forecast of other goods production value-added with the margin of error of 0.13 percentage point. The coefficients of crisis dummy variables introduced in Regression 22.9 are statistically insignificant.

Trade Value-Added. This sector includes retail and wholesale trade, as well as catering. The share of the sector in GDP increased significantly before the crisis, sharply contracted in 1999, and then increased again. In 2003, trade value-added accounted for 19.9% of GDP, up 1.3 percentage points from 1995. This is the second largest sector after industry, and it is sometimes claimed that trade value-added in Russia is overestimated (see Section 1.5). The trade value-added dynamics were close to the dynamics of the economy as a whole – the correlation coefficient between the index of trade value-added and the GDP index was 0.76.
The indicator closest to trade value-added is retail sales. The average absolute value of the difference between the index of trade value-added and the index of retail sales was 3.4 percentage points, less than the similar discrepancy between the agricultural value-added and agricultural production indices, though higher than the discrepancy between the indices of retail sales and household consumption. This difference was the most significant in the middle of the historical sample, in 1999 and 2000, when it was twice in double-digits. The correlation coefficient between the index of trade value-added and the index of retail sales was 0.79. This is high, although not as high as the correlation between the indices of retail sales and household consumption. In general, rather surprisingly, retail sales seems to be more closely linked to household consumption than to trade value-added.

*Figure 3.1.2.6. Russia: Trade Value-Added and Retail Sales, Quarterly Year-Over-Year Indices*
Regression 5.1 provides very accurate current-quarter out-of-sample forecasts of trade value-added (DLTRADEVA) with the margin of error below 0.23 percentage point. This regression includes retail sales (DLRETSales) and principal components. Retail sales variables are included with lags. The coefficient for contemporaneous retail sales introduced in Regression 5.1 is statistically insignificant, despite the fact that retail sales are strongly contemporaneously correlated with trade value-added. If the crisis dummy variables in Regression 5.1 are dropped (see Regression 5.3), the out-of-sample forecasts become just accurate and the adjusted R-squared declines.

\[
DLTRADEVA = C(1) + C(2) \cdot DLRETSales(-1) + \\
C(3) \cdot DLRETSales(-4) + C(4) \cdot PC1 + C(5) \cdot DUMMYPC1 + C(6) \cdot PC8 + \\
C(7) \cdot DUMMYPC1(-4) + [AR(1)=C(8),MA(4)=C(9)] \tag{5.1}
\]

Of the single-variable regressions, the best current-quarter out-of-sample forecasts are provided by the regression with retail sales (5.2) – for one quarter the forecast is very accurate and for the other it is just accurate. The regressions with the Brent crude oil spot price and retail sales inventories (5.4 and 5.6, respectively) generate an accurate forecast for one quarter, while for the other quarter, the forecast is inaccurate. The other single-variable regressions provide inaccurate forecasts for both quarters.

Regression 5.1 produces an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.53 percentage point when the contemporaneous principal components are themselves forecasted. One of the two contemporaneous principal components is forecasted with the use of crisis dummy variables.

Regression 5.8, which includes only lagged retail sales and principal components, provides a very accurate one-quarter-ahead out-of-sample forecast of trade value-added with the margin of error of a mere 0.03 percentage point. It does not contain crisis dummy variables. An introduction of a crisis dummy variable leads to a higher forecast margin of error (see, for example, Regression 5.9) and a decrease in the adjusted R-squared. The forecast margin of error is also a little higher and the adjusted R-squared is
slightly lower if retail sales variables are used without principal components (Regression 5.2). The forecasts produced by both Regression 5.9 and Regression 5.2 are, however, also very accurate.

*Transportation and Communication Value-Added.* Relative to GDP, this small sector was remarkably stable. In 2003, the transportation-value-added to GDP ratio was 8.0%, exactly the same as in 1995. The index of transportation value-added was highly correlated with the GDP index – the correlation coefficient was 0.84.

*Figure 3.1.2.7. Russia: Transportation Value-Added and Freight Transportation (in Ton-Kilometers), Quarterly Year-Over-Year Indices*

The indicator that is most closely related to transportation value-added is freight transportation measured in ton-kilometers. The absolute value of the difference between the two indices was only 1.7 percentage points, and this discrepancy never exceeded 4.4
percentage points. The correlation coefficient between the two indices was a very high 0.95. Nevertheless, the comparison of various regressions showed that more accurate forecasts were generated when freight transportation was not used as the “special” indicator, but, instead, included in the set of indicators from which the principal components were extracted.

Regression 6.1 of transportation value-added (DLTRANSPVA) on principal components generates very accurate current-quarter out-of-sample forecasts with the higher margin of error of 0.46 percentage point. This regression does not contain crisis dummy variables, because they do not improve the out-of-sample forecasts. For example, the forecast provided by Regression 6.2 is border-line accurate for one-quarter and inaccurate for the other. Also, the adjusted R-squared is smaller for Regression 6.2 than for Regression 6.1.

\[
DLTRANSPVA = C(1) + C(2) \cdot PC1 + C(3) \cdot PC6 + C(4) \cdot PC1(-2) + \\
[AR(1)=C(5),AR(4)=C(6),MA(2)=C(7),MA(4)=C(8)]
\]  

(6.1)

None of the estimated single-variable regressions provides very accurate current-quarter out-of-sample forecasts. The best forecasts are produced by a regression with crude oil production (6.6). They are accurate for both quarters. Four regressions – with freight transportation (6.3), the Brent crude oil spot price (6.4), M2 (6.8), and agricultural production (6.9) – generate forecasts that are accurate for one quarter, but either border-line accurate or inaccurate for the other. The regression with freight transportation underestimates the acceleration of transportation value-added growth in the second and third quarters of 2004, apparently reflecting the slowdown of the growth of freight transportation during that period.

Regression 6.1 also provides a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.42 percentage point when the contemporaneous principal

\[^{38}\] Surprisingly, this regression shows that while the contemporaneous impact of oil production on transportation is positive, the lagged impact is negative, and, overall, the negative impact appears stronger.
components are themselves projected. Crisis dummy variables are used in the regressions for both contemporaneous principal components.

Regression 6.10, which includes only lagged principal components, produces a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.13 percentage point. If the crisis dummy variable is dropped from Regression 6.10 (see Regression 6.11), the forecast margin of error rises to 0.14 percentage point, but the adjusted R-squared also slightly increases. Thus, according to the regression selection criteria described in Chapter 1, there is virtually no difference between Regression 6.10 and Regression 6.11.

*Other Market Services Value-Added.* This is a medium-sized sector in the Russian economy. Rather surprisingly, its share in GDP, measured in constant prices, declined during the period under consideration. In 1995, the share of other market services stood at 16.9% of GDP. By 1998, it increased to 17.8%, but then shrank to 15.8% by 2003. 39

The correlation coefficient between the index of other services value-added and the GDP index was 0.54, i.e., it was high, but not as high as the correlation coefficients between the GDP index and the indices of most of the other sectors. To some extent, this is a result of the negative correlation between other market services, on the one hand, and two major GDP components, non-market services and government consumption, on the other hand. Also, the correlation between the index of other market services value-added and the index of trade value-added was a relatively low 0.30. Apparently, there was competition between other market services, on the one hand, and non-market services, government consumption, and trade, on the other hand.

The correlation coefficients between the index of other market services value-added and the indices of many other individual GDP components and monthly indicators were not very high either. A relatively substantial correlation of 0.54 was found between the

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39 By contrast, in current prices, relative to GDP, this sector expanded quite rapidly and almost uninterruptedly during the entire period under consideration.
indices of other market services value-added and paid consumer services. The latter indicator is released monthly, although prior to 1998, it was published only quarterly. Rosstat does not provide any high-frequency indicators describing business services.

**Figure 3.1.2.8. Russia: Other Market Services Value-Added, Paid Consumer Services and Per Capita Consumer Spending on Goods and Services, Quarterly Year-Over-Year Indices**

Paid consumer services include trade and transportation consumer services, which are not included in other market services. At the same time, other market services include business services. Therefore, paid consumer services does not appear to be one of those single most important indicators that statisticians normally use for preliminary estimates of corresponding national account components. In fact, it appears that for other market services there is no such single indicator at all.
Nevertheless, I attempted to apply paid consumer services as the “special” indicator for this national account variable. First, it is one of the two officially released high-frequency indicators that include at least a portion of other market services. The other indicator, per capita consumer spending on goods and services, includes many more activities that are not related to other market services. Second, as mentioned before, paid consumer services had a relatively high correlation with other market services. The correlation between the indices of other market services value-added and per capita consumer spending on goods and services was only 0.27. Third, the average absolute value of the difference between the indices of other market services value-added and paid consumer services was a relatively low 3.4 percentage points. This is less than, for example, the average absolute value of the difference between the agricultural value-added and agricultural production indices (4.7 percentage points). The average absolute value of the difference between the other market services value-added and per capita consumer spending indices was much higher – 6.9 percentage points.

Regression 7.1 of other market services value-added (DLOMSVA) on paid consumer services (DLPSERV) and principal components provides very accurate current-quarter forecasts with the higher margin of error of 0.36 percentage point. If a crisis dummy variable is not included (Regression 7.2), out-of-sample forecasts become just accurate and the adjusted R-squared declines. The forecasts generated by a regression that includes paid consumer services, but no principal components, (7.3) generates a very accurate forecast for the second quarter of 2004. However, the forecast for the third quarter of 2004 is inaccurate. The acceleration of the growth of other market services value-added predicted by Regression 7.3 for the third quarter is much less substantial than the sharp growth acceleration that occurred according to the officially released figures (from 4.1% in the second quarter to 6.8% in the third quarter). At the same time, the adjusted R-squared is marginally higher for Regression 7.3 than for Regression 7.1.

\[
\text{DLOMSVA} = C(1) + C(2)*\text{DLPSERV} + C(3)*\text{PC3} + C(4)*\text{DUMMYPC3} + \\
C(5)*\text{PC5} + C(6)*\text{PC1(-1)} + C(7)*\text{PC3(-1)} + \\
[\text{AR(3)=C(8), MA(1)=C(9), MA(4)=C(10)}] \\ (7.1)
\]
All of the other single-variable regressions also provide very accurate or just accurate current-quarter out-of-sample forecasts for the second quarter of 2004, but substantially underestimate the acceleration of other market services value-added growth in the third quarter. The third quarter forecast margin was, nevertheless, within the “accurate” range for the regression with M2 (7.6). For the rest of the single-variable regressions, it was border-line accurate or inaccurate. Several single-variable regressions – with the Brent crude oil spot price (7.5), M2, and per capita consumer spending on goods and services (7.7) – perform better if estimated on the basis of the post-crisis sample.

Regression 7.1 provides an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 1.49 percentage points when the contemporaneous independent variables are themselves projected. A crisis dummy variable is used in one of the three regressions for the contemporaneous independent variables.

Regression 7.8, which does not include any contemporaneous independent variables, generates an accurate one-quarter-ahead out-of-sample forecast of other market services value-added with a margin of error of 1.45 percentage points. This regression does not contain paid consumer services or crisis dummies. An addition of a crisis dummy (Regression 7.9) or paid consumer services (Regression 7.10) leads to a slightly higher adjusted R-squared, but the forecast becomes border-line accurate.

Non-Market Services Value-Added. This is a relatively small sector. Its share in GDP increased before the crisis, but steadily contracted later. In 2003, non-market services value-added stood at 9.9% of GDP, down from 11.3% in 1995, the most significant decline in the share of a production-side component over the period under consideration. The sector’s dynamics showed very little correlation with the dynamics of the economy as a whole – the correlation coefficient between the GDP and non-market services value-added indices was only 0.22. The growth of non-market services was not closely linked to the growth of almost any of the other individual GDP components. One exception was government consumption – the correlation coefficient between the index of government
consumption and the index of non-market services value-added was 0.86. Unfortunately, Rosstat does not provide any real government consumption indicators on a monthly basis. Therefore, no “special” indicator could be selected for non-market services value-added.

Figure 3.1.2.9. Russia: Non-Market Services Value-Added, Quarterly Year-Over-Year Indices

Regression 8.1 provides very accurate current-quarter out-of-sample forecasts of non-market services value-added (DLNMSVA) with the margin of error below 0.21 percentage point. A peculiar feature of this variable is that the addition of contemporaneous principal components to Regression 8.1 does not improve the out-of-sample forecasts. Moreover, only one right-hand-side variable is entered in the regression with a one-quarter lag. The rest are lagged more than one quarter. This is not surprising taking into account that none of the monthly indicators directly describes any portion of non-market services. The monthly indicators influence government revenues, which affect government spending. In turn, government spending has an impact on non-market services. This leads to a relatively long lag between changes in the monthly indicators and changes in non-market services value-added.
\[ DLNMSVA = C(1) + C(2) \times DLNMSVA(-2) + C(3) \times PC7(-1) + C(4) \times PC7(-2) + C(5) \times PC1(-3) + C(6) \times PC7(-3) + C(7) \times PC3(-4) + [AR(3)=C(8),AR(4)=C(9),MA(4)=C(10)] \]  

(8.1)

An addition of crisis dummy variables does not improve the forecast either. The margin of error of the forecast generated by Regression 8.2, for example, is higher than the Regression 8.1 forecast margin of error, although the forecast remains very accurate. The adjusted R-squared also worsens.

A regression similar to Regression 8.1 estimated for the post-crisis period only (Regression 8.9) generates a very accurate forecast for the second quarter of 2004 – the margin of error is a mere 0.08 percentage point, less than the margin of error of the forecast produced by Regression 8.1. However, the third quarter forecast obtained through regression 8.9 is just accurate, with the margin of error of 0.98. On balance, Regression 8.1 provides more accurate forecasts than Regression 8.9.

Four of the estimated single-variable regressions – with the ratio of consolidated government budget expenditures to revenues (8.4), M2 (8.6), real industrial production (8.7), and the ratio of defense budget expenditures to total consolidated government budget expenditures (8.8) – produce a very accurate current-quarter out-of-sample forecast for one quarter and an accurate forecast for the other quarter. The regressions with the Brent crude oil spot price (8.3) and with retail sales (8.5) generate forecasts that are just accurate for both quarters. Not surprisingly, the regression with the ratio of consolidated government budget expenditures to revenues produces more precise out-of-sample forecasts than any other single-variable regression. With one exception, the estimated single-variable regressions contain only lagged independent variables.

Since there are no contemporaneous independent variables in Regression 8.1, no extra steps are needed to forecast non-market services value-added one quarter ahead.
Net Taxes on Products and Imports. This category also represents the difference between GDP in market prices and GDP in basic prices. The monthly government budget indicators (and their combinations) published by Rosstat do not seem to correspond to this variable. Therefore, no “special” indicator can be identified. This is a relatively small GDP component, which accounted for 10.5% of GDP in 2003, 0.4 percentage point more than in 1995 and 1.9 percentage points more than when it was at its lowest in 1998. Despite the small size of this variable, its index was closely correlated with the index of GDP as a whole – the correlation coefficient was 0.90. Of GDP components, only industrial value-added showed more significant correlation with total GDP.

Figure 3.1.2.10. Russia: Net Taxes on Products and Imports, Quarterly Year-Over-Year Indices

Regression 9.1 on principal components provides an accurate current-quarter out-of-sample forecast of net taxes on products and imports (DLTAXPROD) for the second quarter of 2004 and a very accurate forecast for the third quarter with the higher margin of error of 0.66 percentage point. The out-of-sample forecast substantially worsens – the second quarter margin of error significantly rises, though remaining within the “accurate”
range, and the third quarter forecast becomes inaccurate – when the crisis dummy variable is dropped from Regression 9.1 (see Regression 9.2). Also, the adjusted R-squared declines.

\[
\text{DLTAXPROD} = C(1) + C(2) \cdot PC1 + C(3) \cdot PC2(-1) + C(4) \cdot PC4(-1) + C(5) \cdot DUMMYPC4(-1) + C(6) \cdot PC1(-2) + [AR(1)=C(7),AR(4)=C(8),MA(4)=C(9)] \quad (9.1)
\]

Most of the single-variable regressions produce inaccurate forecasts for both quarters. One exception is the regression with the Brent crude oil spot price (9.3), which generates an accurate forecast for one quarter and a border-line accurate forecast for the other quarter. Somewhat better forecasts are provided by the regression with retail sales – for both quarters the margin of error is within the “accurate” range.

Regression 9.1 generates an accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal component is itself projected. The regression applied to obtain this projection (9.11) includes crisis dummy variables.

Regression 9.9, which includes only lagged explanatory variables, produces a very accurate one-quarter-ahead out-of-sample forecast of net taxes with the margin of error of 0.07 percentage point. This regression includes a crisis dummy variable. If no crisis variables are used (Regression 9.10), the forecast margin of error rises and the adjusted R-squared slightly declines. The forecast remains very accurate, though.

\textit{Household Consumption.} This is the largest Russian real GDP component examined in this study. The share of household consumption in GDP rose from 49.5\% in 1995 to 51.6\% in 1998. It dropped significantly as a result of the 1998 crisis, to 45.9\% of GDP in 2000, but then rebounded and reached 49.7\% in 2003, marginally exceeding the share posted at the beginning of the historical sample. The household consumption index was highly correlated with the overall GDP index (the correlation coefficient was 0.67), but many smaller GDP components demonstrated more substantial correlation with GDP.
The logical choice for the “special” indicator for household consumption is per capita consumer spending on goods and services, which Rosstat estimates monthly. The two variables were strongly correlated – the correlation coefficient between their indices was 0.87. On average, the absolute value of the difference between the two indices was relatively small – 3.0 percentage points, although in two quarters of 1999, this difference was in double-digits. Another possible “special” indicator for household consumption is retail sales. Its disadvantage is that it does not include consumer services. On the other hand, statistically, it appears more suitable to be the household consumption “special” indicator than does per capita consumer spending on goods and services. The correlation coefficient between the household consumption and retail sales indices was 0.92, and the average absolute value of the difference between the two indices equaled 2.0 percentage points.

*Figure 3.1.2.11. Russia: Household Consumption, Per Capita Consumer Spending on Goods and Services and Retail Sales, Quarterly Year-Over-Year Indices*
A regression of household consumption (DLHCONS) on per capita consumer spending (DLREALPCCONS) and principal components extracted from a set of monthly indicators that includes retail sales (10.1) generates very accurate current-quarter out-of-sample forecasts with the margin of error below 0.12 percentage point. For a similar regression specification, in which consumer spending is replaced with retail sales as the “special” indicator and used instead in the set of monthly indicators (10.2), the LM test shows the presence of serial correlation in the residuals. The comparison of Regressions 10.1 and 10.2, in addition to the fact that consumer spending data should be more important than retail sales data for national account statisticians who estimate household consumption, shows that consumer spending is better suited to be the “special” indicator for household consumption.

\[
\begin{align*}
DLHCONS &= C(1) + C(2)*DLREALPCCONS + C(3)*PC2 + \\
&\quad C(4)*DUMMYPC2 + C(5)*PC1(-3) + \\
&\quad [AR(1)=C(6),AR(3)=C(7),AR(4)=C(8),MA(4)=C(9)]
\end{align*}
\] (10.1)

Regression 10.1 contains a crisis dummy variable. Regressions with consumer spending as the “special” indicator, but without crisis dummy variables or principal components (10.3 and 10.4, respectively), still provide very accurate current-quarter out-of-sample forecasts of household consumption, although the margin of forecast error is, on balance, higher than for the Regression 10.1 forecasts.

None of the one-factor regressions, other than the regression with consumer spending, provides very accurate current-quarter out-of-sample forecasts for both quarters. However, regressions with world oil prices (10.5) and retail sales (10.6) generate very accurate out-of-sample forecasts for one quarter. In fact, the second quarter forecast obtained through Regression 10.5 is marginally more precise than the forecast generated by Regression 10.1. The third quarter forecast produced by Regression 10.5 is, however, only border-line accurate. The regressions with M2 (10.7) and average wages (10.8) generate forecasts that are accurate for one quarter and inaccurate for the other.
Regression 10.1 also generates a very accurate one-quarter-ahead out-of-sample forecast when the contemporaneous variables are themselves forecasted – the margin of error is 0.48 percentage point. Crisis dummy variables are used in both contemporaneous variable regressions (10.11 and 10.12).

Regression 10.9, which does not include any contemporaneous independent variables, provides a very accurate one-quarter-ahead out-of-sample forecast of household consumption with a margin of error of 0.4 percentage point. This regression does not contain consumer spending or crisis dummies. The LM test signals the presence of serial correlation in residuals if consumer spending is added. An introduction of a crisis dummy slightly increases the adjusted R-squared, but also results in a slightly higher out-of-sample forecast margin of error (see Regression 10.10). The forecast remains very accurate, though.

Government Consumption. In 2003, Russian government consumption stood at 17.6% of GDP, the lowest share during the period under consideration. Government consumption was substantially higher relative to GDP, at 20.2%, in 1995. After increasing by two percentage points by 1998, the government consumption-to-GDP ratio declined the next year as a result of the crisis and continued to shrink in the following years. Following the crisis, the growth of this variable lagged considerably behind overall economic expansion – the government consumption year-over-year growth rate exceeded 3% only in three quarters. Government consumption is one of the few national account components that showed little correlation with GDP – the correlation coefficient between the indices of these two variables was 0.20. Only consumption by non-commercial organizations serving households was less correlated with GDP.

I do not use a “special” indicator for Russian government consumption. Theoretically, government budget spending could be applied as a “special” indicator. The problem is that available data do not allow for estimating real budget spending in the Russian case.
A regression of government consumption (DLGOV) on principal components (11.1) generates very accurate current-quarter out-of-sample forecasts with the margin of error below 0.12 percentage point. This regression includes a crisis dummy variable. A similar regression without the crisis dummy (11.2) has a marginally low adjusted R-squared coefficient and generates current-quarter out-of-sample forecasts that are marginally less accurate than the forecasts obtained through Regression 11.1.

\[
DLGOV = C(1) + C(2)\cdot\text{DUMMYDLGOV}(-4) + C(3)\cdot\text{PC1} + C(4)\cdot\text{PC2} + C(5)\cdot\text{PC4} + C(6)\cdot\text{PC1}(-4) + [\text{AR}(4)=C(7),\text{MA}(4)=C(8)]
\] (11.1)

Of the estimated one-factor regressions, very accurate current-quarter out-of-sample forecasts of government consumption are provided, rather surprisingly, only by a regression with merchandise exports to CIS countries (11.8). All other estimated one-factor regressions provide forecasts that are just accurate. Regressions of government consumption on world oil prices (11.3) and on the ratio of consolidated government...
budget expenditures to revenues (11.4) provide more precise forecasts when estimated based on the post-crisis sample than when estimated on the basis of the full sample.

Regression 11.1 also generates a very accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal components are themselves forecasted – the margin of error is 0.15 percentage point. Of the three ARMA regressions applied to forecast the contemporaneous principal components, crisis dummy variables were used in one (11.12). One regression (11.13) demonstrates much better in-sample and out-of-sample forecast properties when estimated for the post-crisis sample only.

A very accurate one-quarter-ahead out-of-sample forecast of government consumption – the margin of forecast error is 0.18 percentage point – is provided with Regression 11.9, which does not include any contemporaneous independent variables. The margin of error rises slightly if no crisis dummies are used (see Regression 11.10), and the adjusted R-squared declines. The reduction of the full sample to the post-crisis period (11.11) still allows for obtaining very accurate out-of-sample forecasts, but the margin of error also rises.

**Consumption by Non-Commercial Organizations Serving Households.** This is the second smallest national account component considered in this study. In 2003, the share of consumption by non-commercial organizations stood at a mere 1.0% of GDP, down from 1.2% in 1995 and 1.3% in 1998. Compared to the rest of the economy this variable was very stable. From the first quarter of 2002 through the third quarter of 2004, its growth ranged from −1.9% to 2.0% year-over-year, averaging 0.5%. Estimated for the entire historical sample, the correlation of the index of this consumption and the GDP index was only 0.14, smaller than the correlation between the index of any other national account variable considered in this study and the GDP index. Obviously, there is no “special” indicator for this variable.

Regression 12.1 of consumption by non-commercial organizations serving households (DLNCO) on principal components provides a very accurate current-quarter out-of-
sample forecast – with the margin of error of 0.13 percentage point – for the second quarter of 2004. The forecast for the third quarter of 2004 is just accurate – the margin of error is 1.36 percentage points. In that quarter, after slowly growing or staying flat for several quarters, consumption by non-commercial organizations suddenly declined 1.9% year-over-year. Regression 12.1 does predict a decline in this variable, but not as significant as the officially registered decline.

\[ DLNCO = C(1) + C(2)\ast DLNCO(-1) + C(3)\ast PC1 + C(4)\ast DUMMYPC1 + C(5)\ast PC2 + C(6)\ast DUMMYPC3 + C(7)\ast PC1(-3) + [AR(1)=C(8),AR(2)=C(9),MA(4)=C(10)] \] (12.1)

**Figure 3.1.2.13. Russia: Consumption by Non-Commercial Organizations Serving Households, Quarterly Year-Over-Year Indices**

Regression 12.1 includes crisis dummy variables. After their removal (Regression 12.2), the current-quarter forecast worsens to just accurate for the second quarter of 2004 and to border-line accurate for the third quarter, while the adjusted R-squared declines.
Forecasts produced by single-variable regressions are inaccurate for at least one of the
two quarters. Only one single-variable regression (12.6 – with average wages) provides
an accurate forecast for one quarter. Three regressions – with the world oil price (12.3),
M2 (12.4), and employment (12.7) – generate border-line forecasts for one quarter. The
forecast produced by the other regressions are inaccurate for both quarters.

Regression 12.1 generates an accurate one-quarter-ahead out-of-sample forecast when the
contemporaneous principal components are themselves forecasted – the margin of error is
1.06 percentage points. One ARMA regression applied to forecast a contemporaneous
principal component (12.11) is estimated on the basis of the post-crisis sample. Crisis
dummy variables are included in the other two ARMA regressions (12.12 and 12.13).

Regression 12.9, which does not include any contemporaneous independent variables,
generates a very accurate one-quarter-ahead out-of-sample forecast of consumption by
non-commercial organizations – the margin of error is 0.29 percentage point. The margin
of error significantly rises if no crisis dummies are used (12.10), and the forecast
becomes just border-line accurate. The adjusted R-squared drops sharply in this case.

*Gross Fixed Investment.* This variable equaled 22.9% of GDP in 1995, but shrank to
15.7% of GDP by 1998. After the crisis, fixed investment slowly increased relative to
GDP. In 2003, the share of fixed investment was 18.2%, still significantly below what it
was in 1995. The correlation coefficient between the fixed investment index and the GDP
index was 0.84, much more significant than the correlation coefficient between the index
of any other expenditure-side national account component and the GDP index.

Fixed investment is calculated in Russia not only quarterly, as a national account
variable, but also monthly. The absolute value of the difference between the indices of
these two variables was 3.6 percentage points for the historical sample as a whole. This
discrepancy was much larger prior to the beginning of 1998 than after that. When
calculated for the latter period only, the absolute value of the difference between the two
indices drops to 1.4 percentage points, and in the first three quarters of 2004, the
discrepancy did not exceed 0.63 percentage point. If the conversion trend between the
two indices continues, full-quarter “monthly” fixed investment data may become
sufficient for a very accurate estimate of national account fixed investment. In the
meantime, fixed investment calculated according to the “monthly” methodology can be
used as the “special” indicator for national account fixed investment.

**Figure 3.1.2.14. Russia: Fixed Investment (National Accounts and “Monthly”
Methodology), Quarterly Year-Over-Year Indices**

Since the discrepancy between the two indices narrowed sharply in early 1998, the 1996-
1997 observations are excluded from the sample on the basis of which fixed investment
regressions are estimated. It does not appear that the narrowing of the discrepancy was
related to the crisis. As the “monthly” fixed investment indices were close to the national
account fixed investment indices in the pre-crisis quarters of 1998, all of the 1998
quarters are included in the estimation sample. After adjustment due to the introduction
of lagged variables, the sample actually starts after the crisis for many regressions.
considered here. In the estimated regressions, when the sample starts before the fourth quarter of 1998, crisis dummy variables are statistically insignificant.

Regression 13.1 of national account fixed investment (DLINVNA) on “monthly” fixed investment (DLFIXEDINV) and a principal component provides very accurate current-quarter out-of-sample forecasts with the margin of error below 0.26 percentage point. If the principal component is excluded (Regression 13.2), the adjusted R-squared slightly declines, and the forecast for the third quarter of 2004 becomes just accurate. Although the margin of error for the second quarter is slightly reduced when the principal component is excluded, on balance, the margin of error is much smaller for Regression 13.1 than for Regression 13.2.

\[
DLINVNA = C(1) + C(2) \times DLFIXEDINV + C(3) \times PC2 + \]
\[
[AR(1)=C(4), AR(2)=C(5), MA(3)=C(6)] \tag{13.1}
\]

Of the estimated single-variable regressions, not counting the regression with “monthly” fixed investment, only the regression with construction (13.5) produces accurate current-quarter out-of-sample forecasts for both quarters. The regression with the world oil price (13.3) generates an accurate forecast for one quarter, while the forecast for the other quarter is inaccurate. The other single-variable regressions produce inaccurate forecasts for both quarters.

Regression 13.1 generates an accurate out-of-sample one-quarter-ahead forecast – with the margin of error of 1.01 percentage points – when the contemporaneous independent variables are themselves forecasted. Regression 13.7, which includes only lagged independent variables, provides a very accurate one-quarter-ahead out-of-sample forecast of fixed investment. The margin of error is 0.31 percentage point. The coefficients of “monthly” fixed investment (with various lags) added to Regression 13.7 are statistically insignificant.
**Investment Ratio.** Since during the period under consideration the values of change in inventories were both positive and negative, which makes their indices meaningless, it was decided not to project this variable directly, but to forecast instead the ratio of the index of total investment to the index of gross fixed investment.

*Figure 3.1.2.15. Russia: Investment Ratio (100 when the total investment index equals the gross fixed investment index)*

This ratio was extremely volatile. It dropped sharply as a result of the crisis, mostly because of a substantial decline in inventories, and surged in the second half of 1999 and the beginning of 2000, when inventories increased in some quarters or declined only slightly in the other quarters. Because of this crisis-related volatility, the regression estimation sample for this variable was reduced to the period starting in the first-quarter of 2000.

Regression 14.1 of the investment ratio (DLINVRATIO) on principal components produces an accurate current-quarter out-of-sample forecast for one quarter and a very accurate forecast for the other quarter with the higher margin of error of 0.60 percentage point. Despite the precision of the investment ratio and gross fixed investment forecasts,
the derived forecast of change in inventories was inaccurate for the second quarter of 2004, with the margin of error of 7.1 percentage points. This substantial inaccuracy was in large part due to the small size of this GDP component in that quarter.

\[ \text{DLINVRATIO} = C(1) + C(2) \cdot PC1 + C(3) \cdot PC2 + C(4) \cdot PC4 + [\text{AR}(1)=C(5),\text{MA}(4)=C(6)] \] (14.1)

Most of the estimated single-variable regressions produce inaccurate current-quarter out-of-sample forecasts of the investment ratio. The regression with retail sales (14.5) and the regression with industrial production (14.4) generate, respectively, an accurate and a border-line accurate forecast for one quarter, while the forecasts for the quarter are inaccurate.

Regression 14.1 also produces an accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal components are themselves projected. The margin of error is 1.02 percentage points. One of these principal components is estimated using a regression with crisis dummy variables (14.9), and the other two are forecasted on the post-crisis sample (Regressions 14.10 and 14.11).

Regression 14.8, which includes only lagged explanatory variables, produces a very accurate one-quarter-ahead out-of-sample forecast of the investment ratio with the margin of error of 0.29 percentage point.

Exports. Exports of goods and services grew relative to GDP both before and after the crisis. In 2003, they reached 35.3% of GDP, up eight percentage points from 1995. This variable was less correlated with GDP than were many other national account components – the correlation coefficient between the indices of exports and GDP was 0.46.

Of the monthly indicators, merchandise exports measured in U.S. dollars appears the closest to real exports of goods and services. However, the former fluctuated much more
substantially than the latter due to sharp changes in international prices (primarily the prices of energy resources) to which real exports could not adequately react due to capacity constraints. The correlation coefficient between the indices of these two variables was only 0.51, less than the correlation coefficient between the index of any of the Russian national account variables and the index of its “special” indicator. The average absolute value of the difference between the indices of exports of goods and services and merchandise exports was 14.7 percentage points, greater than the discrepancy between the indices of any other national account variable and its “special” indicator.

Figure 3.1.2.16. Russia: Exports of Goods and Services and Merchandise Exports (in U.S. Dollars), Quarterly Year-Over-Year Indices

Regression 15.1 of exports of goods and services (DLEXPGS) on merchandise exports (in U.S. dollars) (DLEXPORTS) and principal components generates accurate current-quarter out-of-sample forecasts with the margin of error below 1.22 percentage points.
Crisis dummy variables do not help improve out-of-sample forecasts in this case. Often, if a crisis dummy is added to Regression 15.1, the LM test signals the presence of serial correlation in the residuals. When serial correlation is not present, the coefficient for the added crisis dummy is statistically insignificant.

\[
\text{DLEXPGS} = C(1) + C(2)\times\text{DLEXPORTS} + C(3)\times\text{DLEXPORTS}(-1) + \\
C(4)\times\text{PC1} + C(5)\times\text{PC8} + C(6)\times\text{PC1}(-2) + C(7)\times\text{PC10}(-3) + \\
[AR(1)=C(8),AR(2)=C(9),AR(3)=C(10),AR(4)=C(11),MA(2)=C(12),MA(4)=C(13)]
\]  

Most of the single-variable regressions, including the regression with merchandise exports (15.2), provide inaccurate out-of-sample forecasts for both quarters. One exception is the regression with crude oil production (15.4), which provides an accurate forecast for the second quarter of 2004.\(^{40}\) Another exception is the regression with the exchange rate (15.6), whose forecast for the second quarter is border-line accurate.

When the contemporaneous independent variables are themselves forecasted, Regression 15.1 produces an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 1.36 percentage points. Crisis dummies are used in two of the three regressions of the contemporaneous independent variables.

A one-quarter-ahead out-of-sample forecast of exports of goods and services obtained through Regression 15.7, which includes only lagged independent variables, is also just accurate. The margin of error is 1.02 percentage points. The forecast becomes inaccurate and the adjusted R-squared significantly declines if the crisis dummies or the principal components are dropped (Regressions 15.8 and 15.9, respectively).

\(^{40}\) The problem is that this regression shows that lagged crude oil production has a negative impact on exports of goods and services, while the coefficient for contemporaneous crude oil production is statistically insignificant. As mentioned before, lagged crude oil production also has a negative impact on transportation value-added.
Imports. Imports of goods and services stood at 20.7% of GDP in 1995. They dropped to 14.6% of GDP in 1999 as a result of the crisis, but quickly grew thereafter, reaching 23.9% of GDP in 2003. The growth of imports substantially outpaced the growth of exports, both in absolute terms and relative to GDP. Nevertheless, the foreign trade surplus remains very high – in 2003, it stood at 11.4% of GDP. Despite the fact that imports enter the national account identities with the negative sign, the correlation coefficient between the imports and GDP indices was 0.67, i.e., it was positive and high. In fact, it was higher than the correlation coefficient between the export and GDP indices.

Figure 3.1.2.17. Russia: Imports of Goods and Services and Merchandise Imports (in U.S. Dollars), Quarterly Year-Over-Year Indices

Merchandise imports measured in U.S. dollars is applied here as the “special” indicator for real imports of goods and services. The absolute value of the difference between the indices of these variables was 6.8 percentage points, on average. This is much less significant than the discrepancy between the indices of exports of goods and services and
merchandise exports, although more substantial than the discrepancy between the index of any other national account variable and its respective “special” indicator index. The index of imports of goods and services was highly correlated with the index of merchandise imports, with the correlation coefficient equaling 0.91. This correlation is much stronger than the correlation between exports of goods and services and merchandise exports, possibly because it is easier for importers to react to international price changes than it is for exporters.

Regression 16.1 of imports of goods and services (DLIMPGS) on merchandise imports (DLIMPORTS) and principal components provides an accurate current-quarter out-of-sample forecast for the second quarter of 2004 and a very accurate forecast for the third quarter. The higher margin of error is 1.0 percentage point. This regression does not contain crisis dummy variables. An introduction of crisis dummies does not improve the out-of-sample forecasts, although it may raise the adjusted R-squared (see Regression 16.2, for example). If the principal components are dropped from Regression 16.1, the second quarter forecast margin of error rises, while remaining within the "accurate" range, and the third quarter forecast becomes border-line accurate (see Regression 16.3). The adjusted R-squared substantially declines.

\[
\text{DLIMPGS} = C(1) + C(2)\times\text{DLIMPGS}(-4) + C(3)\times\text{DLIMPORTS} + C(4)\times\text{PC1} + C(5)\times\text{PC2} + C(6)\times\text{PC7} + C(7)\times\text{PC1}(-4) + [\text{AR}(4)=C(8),\text{MA}(3)=C(9)] \quad (16.1)
\]

All of the estimated single-variable regressions, with the exception of the regression with merchandise imports, provide inaccurate current-quarter out-of-sample forecasts for both the second and the third quarters of 2004.

Regression 16.1 generates a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.27 percentage point when the contemporaneous independent variables are themselves projected. Of the four contemporaneous independent variables, two are projected using crisis dummy variables, and two are forecasted based on the post-crisis sample.
Regression 16.8, which includes only lagged independent variables, provides an accurate one-quarter-ahead out-of-sample forecast of imports of goods and services with the margin of error of 0.63 percentage point. If crisis dummies are dropped from this regression, the White test points to the presence of heteroscedasticity in the residuals. The coefficient for merchandise imports becomes statistically insignificant if the principal components are omitted.

*Nominal GDP.* The nominal GDP index was much more strongly correlated with the GDP deflator index than with the real GDP index – the respective correlation coefficients were 0.95 and 0.33. Because of inflation acceleration, nominal GDP growth was especially high in the quarters following the crisis – in the third quarter of 1999, nominal GDP more than doubled from a year earlier. After inflation cooled down by the end of 2000, nominal GDP growth ranged from 18.5% to 28.7% year-over-year. The latter rate was actually observed in the third quarter of 2004, as inflation accelerated toward the end of the historical sample.

*Figure 3.1.2.18. Russia: Nominal GDP, Quarterly Year-Over-Year Indices*
A regression of nominal GDP (DLNGDP) on principal components (17.1) provides an accurate current-quarter out-of-sample forecast for the second quarter of 2004 and a very accurate forecast for the third quarter – the higher margin of error being 0.68 percentage point. If the crisis dummy variable is dropped from Regression 17.1 (see Regression 17.2), the second quarter forecast remains accurate, but the third quarter projection becomes inaccurate. Also, the adjusted R-squared coefficient slightly declines.

\[ \text{DLNGDP} = C(1) + C(2)\times PC1 + C(3)\times PC2 + C(4)\times PC1(-1) + C(5)\times DUMMYPC1(-1) + [MA(4)=C(6)] \quad (17.1) \]

All of the partial derivatives of nominal GDP with respect to the monthly indicators are positive, except for the derivative with respect to real retail sales, which is negative, being very close to zero. The sign of the real retail sales partial derivative seems counterintuitive since it means that an increase in a major type of economic activity leads to a decline in overall economic activity. However, the negative impact of real retail sales on nominal GDP can be confirmed through other methods. In a single-variable regression of nominal GDP on real retail sales (17.4), the real retail sales coefficients, for both contemporaneous and lagged indicators, are negative. The correlation coefficient between the real retail sales and nominal GDP indices was also negative (-0.40). This negative impact of real retail sales on nominal GDP can be explained by the negative impact of the former on the GDP deflator (the correlation coefficient between the real retail sales and GDP deflator indices was -0.59). Apparently, an increase in the supply of consumer goods causes a decline in prices.\(^{41}\) The partial derivative of nominal GDP with respect to real retail sales is very small in absolute terms, probably because the estimation of partial derivatives assumes that the other indicators, including those representing major price categories, remain unchanged. Real retail sales plays an important role in the set of monthly indicators from which the principal components are extracted. If real retail sales

\(^{41}\) By contrast, the correlations between the real industrial production index, on the one hand, and the nominal GDP and GDP deflator indices, on the other hand, were positive.
is replaced in this set with nominal retail sales, the coefficient for PC2 in Regression 17.1 becomes statistically insignificant and the adjusted R-squared substantially declines.

Two one-factor regressions – with real retail sales (17.4) and consumer prices (17.6) – provide very accurate or just accurate current-quarter out-of-sample forecasts for one of the two quarters, but the forecast for the other quarter is inaccurate. The regression with the nominal average wage (17.8) generates an accurate forecast for one quarter and a very accurate forecast for the other. The rest of the estimated single-variable regressions produce inaccurate forecasts for both quarters. The single-variable regression with the Brent crude oil spot price (17.3) has substantially better properties when estimated on the basis of the post-crisis sample than on the basis of the full sample.

Regression 17.1 also produces an accurate one-quarter-ahead out-of-sample forecast – with the margin of 0.83 percentage point – when the contemporaneous principal components are themselves projected. Both regressions applied to project these principal components (17.11 and 17.12) include crisis dummies.

Regression 17.9, which includes only lagged independent variables, provides a very accurate next-quarter out-of-sample forecast of nominal GDP for the third quarter of 2004. The margin of error is 0.19 percentage point. The forecast becomes just accurate and the adjusted R-squared slightly declines if the crisis dummy variable is not included.

Nominal Employees’ Compensation. This variable, which contains both reported and hidden compensation, is currently the largest nominal GDP component. In 1995, it accounted for 45.4% of GDP. By 1997, the share of employees’ compensation rose to 51.4% of GDP, but then plunged, as a result of the crisis, to 40.1% of GDP by 1999, falling below the share of profit and mixed income. It gradually rose after 1999, reaching 46.9% in 2003. Employees’ compensation strongly correlated with nominal GDP – the correlation coefficient between the indices of these two variables was 0.79.
The logical choice for the “special” indicator for nominal employees’ compensation is nominal average wage. The absolute value of the difference between the indices of these two variables was not small during most of the historical period. Frequently, it was in double digits, and, on average, it equaled 7.4 percentage points. However, there was a clear tendency for the two indices to converge. In the second and third quarters of 2004, the absolute value of the difference was below 0.1 percentage point, which could be a result of a rounding error. The conversion occurred because of the reduction in wage arrears and, possibly, in hidden compensation. Because of the conversion trend and the fact that the two indices were virtually identical in the last two quarters of 2004, a current-quarter forecasting model was not built for this GDP component. It appears that full-quarter nominal wage data have become sufficient to make a very accurate estimate of nominal employees’ compensation for the same quarter.

*Figure 3.1.2.19. Russia: Nominal Employees’ Compensation and Nominal Average Wage, Quarterly Year-Over-Year Indices*
Therefore, for this variable, only a one-quarter-ahead forecasting model was constructed. Regression 18.1, which contains no contemporaneous variables, provides a very accurate out-of-sample forecast of nominal employees’ compensation (DLNEC) with the margin of error of 0.16 percentage point. The forecast becomes border-line accurate and the adjusted R-squared significantly declines if the crisis dummy variable is dropped (18.2). The forecast turns inaccurate and the adjusted R-squared plummets if nominal average wage (DLNOMWAGE) is used as the single independent variable without any principal components (18.3).

\[
\text{DLNEC} = C(1) + C(2)*\text{DLNOMWAGE}(-1) + C(3)*\text{PC1}(-1) + C(4)*\text{PC5}(-1) + C(5)*\text{PC8}(-1) + C(6)*\text{PC1}(-2) + C(7)*\text{DUMMYPC1}(-2) + [\text{AR}(1)=C(8),\text{AR}(2)=C(9),\text{MA}(4)=C(10)]
\]  

(18.1)

Nominal Gross Profit and Mixed Income. The share of this variable in GDP fluctuated widely during the period under consideration, plunging to 33.4% in 1997 and peaking at 44.2% in 1999. In 2003, it stood at 40.3%, 2.5 percentage points less than at the beginning of the historical sample. The correlation coefficient between the index of profit and mixed income and the nominal GDP index was 0.86, more significant than the correlation coefficient between the employees’ compensation index and the nominal GDP index, despite the fact that employees’ compensation exceeded profit and mixed income during most of the period under consideration.

Rosstat provides profit figures on a monthly basis. However, the monthly profit indicator does not appear to be suitable for the role of the “special” indicator for national account profit and mixed income. First, in several quarters, profit calculated on the basis of the “monthly” methodology was negative, while national account profit and mixed income was always positive. Second, from the first quarter of 2000 through the end of the historical sample, a period during which the quarterly index of profit calculated using the “monthly” methodology was consistently positive, the absolute value of the difference between the “monthly” methodology profit index and the index of profit and mixed income was very high – 38.9 percentage points, on average. We can see from Figure...
3.1.2.20 that the “monthly” methodology profit index was much more volatile than the index of profit and mixed income.

Regression 19.1 provides accurate current-quarter out-of-sample forecasts of nominal profit and mixed income (DLPROFIT) with the margin of error below 1.19 percentage points. It is remarkable that this regression accurately predicts the sharp acceleration of the growth of the dependent variable in the second quarter of 2004 – to 31.3% year-over-year from 20.0% in the first quarter, according to the official data. Regression 19.1 contains a crisis dummy variable that plays a very important role in predicting the second quarter growth acceleration. If this variable is dropped, the forecast becomes inaccurate with the forecast margin of error exceeding four percentage points (see Regression 19.2). The goodness of fit measured by the adjusted R-squared also declines.
\[
\text{DLPROFIT} = C(1) + C(2)*PC1 + C(3)*PC7 + C(4)*PC8 + C(5)*PC3(-1) +
C(6)*PC4(-3) + C(7)*PC1(-4) + C(8)*DUMMYPC1(-4) +
[AR(1)=C(9),MA(4)=C(10)]
\] (19.1)

Almost all of the single-variable regressions produce inaccurate current-quarter out-of-sample forecasts of nominal profit and mixed income for both quarters. One exception is the regression with industrial producer prices (19.5), which generates a borderline accurate forecast for one of the two quarters.

Regression 19.1 also generates an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.81 percentage point when the three contemporaneous principal components are themselves projected. Two of these principal components are projected with the use of crisis dummies (Regressions 19.11 and 19.13). One principal component is estimated from the post-crisis sample (Regression 19.12).

Regression 19.9, which contains only lagged principal components, provides an accurate one-quarter-ahead out-of-sample forecast of profit and mixed income with the margin of error of 1.1 percentage points. An addition of crisis dummies to this regression does not help improve the forecast. For example, the forecast obtained from Regression 19.10 is borderline accurate. The adjusted R-squared for Regression 19.10 is slightly lower than for Regression 19.9.

Nominal Net Indirect Taxes on Production and Imports. This category represents the smallest income-side GDP component. In 2003, these taxes stood at 13.9% of GDP, below the peak of 17.1% in 2000, but two percentage points higher than at the beginning of the historical sample. Despite its relatively small size, this GDP component strongly correlated with GDP – the correlation coefficient was 0.79. The monthly government budget indicators published by Rosstat (as well as their combinations) do not seem to correspond to this category of net taxes used in national accounts. Therefore, no “special” indicator was selected.
The current-quarter out-of-sample forecasts of nominal net indirect taxes on production and imports (DLNTAX) obtained from Regression 20.1 are accurate with the margin of error below 1.42 percentage points. Similar to the case of non-market services value-added, the introduction of contemporaneous principal components to Regression 20.1 does not improve the out-of-sample forecasts. This can probably be explained by the fact that in the set of monthly indicators there is only one indicator related to taxes (consolidated government budget revenues) and one indicator remotely related to subsidies (consolidated government budget expenditures). The rest of the indicators just describe the general economic situation. Apparently, there is a lag between a change in economic conditions and the receipt of taxes (and the payment of subsidies).

\[
DLNTAX = C(1) + C(2)\times PC1(-1) + C(3)\times PC3(-1) + C(4)\times PC2(-2) + \\
C(5)\times PC1(-4) + C(6)\times PC3(-4) + C(7)\times PC4(-4) + [AR(1)=C(8),MA(4)=C(9)] 
\]  (20.1)
An introduction of crisis dummy variables does not improve the out-of-sample forecast either - see Regression 20.2, for example. The adjusted R-squared is slightly higher for Regression 20.2 than for Regression 20.1, but the forecast margins of error are also higher for both quarters. The forecast obtained for the second quarter of 2004 becomes inaccurate, if Regression 20.2 is applied.

The current-quarter out-of-sample forecasts generated by most of the single-variable regressions are inaccurate for both quarters. The two exceptions are regressions with the Brent crude oil spot price and consumer prices (20.4 and 20.5, respectively). For one of the two quarters, the forecast generated by the former is accurate and the forecast produced by the latter is border-line accurate.

Since there are no contemporaneous independent variables in Regression 20.1, no extra steps are needed to forecast the dependent variable one-quarter ahead.

*GDP Deflator.* During most of the period under consideration, the rise in the GDP deflator was in the range between the rises in consumer prices and industrial producer prices. For example, during and immediately after the crisis, consumer prices grew faster than the deflator, which, in turn, grew faster than industrial producer prices. By contrast, in 2004, the rise in industrial producer prices exceeded the rise in the deflator, which was higher than the rise in consumer prices.

Both consumer prices and industrial producer prices may be considered for the role of the “special” indicator for the GDP deflator. One problem is that it is difficult to choose between the two. Each of these two indicators covers a considerable portion of prices that constitute the deflator, and the deflator index was strongly correlated with both the consumer price index and the industrial producer price index – the correlation coefficient in both cases was 0.90. In turn, consumer prices and industrial producer prices were highly correlated with each other – the correlation coefficient between the indices of the two indicators was 0.67. Thus, the simultaneous use of both indicators as “special” indicators would result in significant multicollinearity. Another problem is that despite
the strong correlation, the average absolute value of the difference between the deflator index, on the one hand, and the indices of consumer prices and industrial producer prices, on the other hand, was substantial – 8.7 and 7.3 percentage points, respectively. Therefore, no “special” indicator was used in this case, and consumer and industrial producer prices were treated equally. Their elements were included in the set of indicators from which the principal components were extracted.

Figure 3.1.2.22. Russia: GDP Deflator, Consumer Prices, and Industrial Producer Prices, Quarterly Year-Over-Year Indices

Regression 21.1 of the GDP deflator (DLDEFLATOR) on principal components provides very accurate current-quarter out-of-sample forecasts with the higher margin of error of 0.34 percentage point. This regression does not include crisis dummy variables. The coefficients of crisis dummies entered into this regression are insignificant.
DLDEFLATOR = C(1) + C(2)*PC1 + C(3)*PC1(-1) + C(4)*PC2(-1) + C(5)*PC2(-2) + C(6)*PC7(-4) + [AR(1)=C(7),MA(4)=C(8)] (21.1)

All of the partial derivatives of the GDP deflator with respect to the monthly indicators are positive except for the derivatives with respect to real construction and merchandise imports (see Table 21.3 in Appendix A). No partial derivative has a sign that appears counterintuitive. The sign of the deflator partial derivative with respect to a real production variable, such as real construction, can be either positive or negative. For example, an increase in real output may lead to an increase in the deflator through the rising costs of production or may lead to a decline in the deflator through rising supply. The negative sign of the derivative with respect to merchandise imports can be explained by the fact that a rise in imports increases the availability of goods in the domestic markets. The negative impact of merchandise imports on the deflator can be confirmed through other methods. In a single-variable regression of the deflator on merchandise imports (21.5), the coefficient for contemporaneous merchandise imports is negative. The correlation coefficient between the merchandise imports and deflator indices is also negative (-0.47).

Of the single factor regressions, the best current-quarter out-of-sample forecasts – accurate in both quarters – are provided by the regression with the nominal exchange rate (21.4). Two more regressions – those with industrial producer prices (21.3) and with merchandise imports (21.5) generate accurate forecasts for both quarters. The forecasts obtained through the rest of the single-variable regressions are inaccurate.

Regression 21.1 also generates a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.12 percentage point when the contemporaneous principal component is itself projected. The ARMA regression that is used to project this principal component includes a crisis dummy variable.

Regression 21.8, which includes only lagged principal components, provides a very accurate one-quarter-ahead out-of-sample deflator forecast with the margin of error of
0.08 percentage point. This regression includes a crisis dummy variable. When this dummy variable is dropped, the White test signals the presence of heteroscedasticity in the residuals.
3.2. Armenian High-Frequency Model

3.2.1. Armenian Economic Growth and Its Factors

Armenian GDP dramatically contracted in 1992-1993, the first two years of independence, as the problems of the initial stages of market transformation were exacerbated by the conflict with Azerbaijan. However, since 1994, the Armenian economy has been expanding uninterruptedly, and in the past several years, it has become one of the fastest growing economies in the world. Armenian GDP did not decline even after the Russian 1998 crisis, although economic growth slowed in 1999. In 1996, immediately preceding the period considered in this dissertation, Armenian GDP stood at 63.3% of the 1991 level. On average, the Armenian economy expanded 8.0% in 1997-2003, and growth was in double-digits in 2002 and 2003. In 2003, Armenian GDP rose to 108.5% of the 1991 level, while in many other CIS countries, including Russia, Azerbaijan, and Georgia, GDP remained below the levels reached in 1991. Preliminary data show that economic expansion slowed in 2004, but, nevertheless, again exceeded 10%.

Armenia has been more successful in restraining inflation than has Russia. After posting triple-digit and four-digit increases in the first half of the 1990s, the GDP deflator declined in 2000. At the same time, inflation accelerated toward the end of the period under consideration. In the third quarter of 2004, the GDP deflator rose 8.0% year-over-year, the most significant increase since the second quarter of 1998.

The remarkable growth performance took place in Armenia despite the fact that the country is not rich in exportable natural resources. Moreover, the closed borders with Azerbaijan and Turkey have hampered the realization of Armenia’s comparative advantages. Nevertheless, in 1997-2003, the country’s economy grew just a little slower than the economy of neighboring oil-rich Azerbaijan, which expanded 9.4% per year, on average. It does not appear that strong GDP growth received a boost from a rise in population and employment. The analysis of employment trends in Armenia is
complicated by the incomparability of data before and after the 2001 Census. Nevertheless, it is possible that employment actually declined: in 2001, employment was less than in 1999; and in 2003 it was the same as in 2002. It is also possible, however, that the number of hours actually worked substantially increased, but this is difficult to measure.

Figure 3.2.1.1. Armenia: Annual Real GDP and Price Growth Rates (%)

![Graph showing Armenia's annual Real GDP and Price Growth Rates from 1997 to 2003. Real GDP is represented by light gray bars, and Prices by dark gray bars.](image)

The outstanding economic growth rates achieved by Armenia are partially a result of pro-business economic policies, including market transformation in general, as well as recent measures to improve the investment climate (Roudoi et al, 2004). According to the IMF, “Armenia is reaping the benefits of a decade of reforms” (IMF, 2004b, p. 5).

Despite the achievements on the economic growth and inflation fronts, serious economic problems persist in the country. Armenia is still very poor. In fact, with per capita annual GDP of about $800, it is one of the poorest countries in the lower middle-income group,
as defined by the World Bank. The unemployment rate, measured according to the ILO methodology, was 31.2% in 2003.

The strong GDP growth rates have helped reduce poverty over the past several years. However, despite the recent improvement in the business climate, the sustainability of strong growth is questionable.

Figure 3.2.1.2. Armenia: Labor Income, Government Transfers, and Private Transfers, mln. $US

Armenia has enjoyed considerable financial support from abroad. This support allowed the country to consume more than it produced during almost all of the post-Soviet period. In 1997-2003, annual consumption exceeded GDP by 5.9%, on average. It is generally believed that this support, in the form of current private and public transfers as well as labor income from abroad, was a crucially important, if not the main, factor behind strong
economic growth. Official data show that annual average current transfers and labor income combined amounted to 14.0% of GDP in 1997-2003. In reality, these flows were, most likely, much higher. The IMF indicates that Armenian actual workers’ remittances may equal between 15% and 25% of GDP (IMF, 2004b, p. 9).

Economic growth acceleration in 2002 and 2003 is often linked to the unprecedented levels of private transfers in those years (see Figure 3.2.1.2). Private transfers in those years were directly linked to the financing of large investment projects in infrastructure and housing. In 2002 and 2003, investment increased 22.5% and 33.9%, respectively. In general, the perceived importance of labor income and current transfers for the Armenian economy is on par with the perceived importance of world oil prices for the Russian economy.

At the same time, economic growth slowed in 2004 despite a sharp acceleration of the growth of private transfers – from 33.4% in 2003 to 84.5% year-over-year in the first three quarters of 2004. Labor income growth also accelerated, though marginally, from 26.9% to 27.9%.

One problem with the analysis of the impact of labor income and private transfers on Armenian GDP may be the fact that the Armenian Central Bank substantially underestimates these indicators, as the IMF suggests (see above). Armenia receives a significant portion of current private transfers and almost all of its official transfers from Western countries. At the same time, most of labor income and a substantial portion of private transfers come from Russia. Taking into consideration Russian economic growth in the forecasting of Armenian economic growth may compensate for the poor quality of the balance of payments data in Armenia.

Russia is also an important export destination for Armenian goods. The Russian share in Armenian merchandise exports was 13.8% in 2003, and Russia was ranked third in the list of the Armenian export destination countries, following Israel and Belgium. However, these figures underestimate the Russian role in Armenian exports. Armenian
trade is heavily concentrated in diamonds. The country buys uncut diamonds and sells processed diamonds, mostly to Israel and Belgium. In 2003, precious and semi-precious stones and precious metals accounted for 51% of Armenian exports. However, the importance of these large-scale operations for Armenian economic development and employment, in particular, is, apparently, much less significant. In 2002 and 2003, the difference between the values of exports and imports in this category equaled, respectively, only 1.9% and 0.6% of GDP. After subtracting the exports of precious and semi-precious stones and precious metals exports from total exports, the Russian share in Armenian exports may be close to a quarter. If non-registered exports were included, the Russian share would rise even further.

Russian economic growth slowed in 2004, but only marginally. This slowdown was less substantial than the slowdown of economic growth in Armenia.

The deceleration of Armenian GDP expansion in 2004 would have been much more significant without an acceleration of the growth of agriculture from 4.3% in 2003 to 16.8% in the first three quarters of 2004. This very important sector is highly dependent on the weather conditions and is considered less responsive to the flows of funds from abroad than most of the other sectors of the economy.

Although the role of agriculture declined during most of the period under consideration, it still remains much more significant than in the lower middle-income former Soviet Union (FSU) countries, in general. In 2003, agricultural value-added equaled 23.5% of total value-added produced in the Armenian economy. According to the World Development Indicators (World Bank, 2004b), this indicator was 14.7%, on average, in the FSU lower middle-income countries in 2002.

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42 In large part because of the importance of agriculture, quarterly GDP patterns in Armenia are highly seasonal, more seasonal than in Russia. While in Russia, real GDP in the second half of a given year was, on average, 15.7% higher than in the first half, in Armenia, July-December GDP exceeded January-June GDP by 105% (see Figure 3.1.2.3). The GDP deflator is far less seasonal than the other Armenian national account variables forecasted here.
Figure 3.1.2.3. Armenia: Quarterly Real GDP and Prices (1996Q4 = 100)

Table 3.2.1.1. Correlations between the Indices of Armenian GDP and the Indices of Labor Income, Current Transfers, and Russian GDP

<table>
<thead>
<tr>
<th>Lag, quarters</th>
<th>Labor income</th>
<th>Government transfers</th>
<th>Private transfers</th>
<th>Russian GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.372</td>
<td>0.117</td>
<td>-0.041</td>
<td>-0.041</td>
</tr>
<tr>
<td>1</td>
<td>0.408</td>
<td>0.027</td>
<td>-0.073</td>
<td>-0.004</td>
</tr>
<tr>
<td>2</td>
<td>0.519</td>
<td>-0.095</td>
<td>-0.005</td>
<td>0.102</td>
</tr>
<tr>
<td>3</td>
<td>0.321</td>
<td>0.028</td>
<td>-0.034</td>
<td>0.220</td>
</tr>
<tr>
<td>4</td>
<td>0.311</td>
<td>-0.132</td>
<td>0.309</td>
<td>0.427</td>
</tr>
<tr>
<td>5</td>
<td>0.281</td>
<td>0.012</td>
<td>0.404</td>
<td>0.568</td>
</tr>
</tbody>
</table>

Thus, it appears that the flows of funds from abroad are not sufficient to explain economic growth short-term fluctuations. The analysis of correlations between the
Armenian GDP index and the indices of labor income, current transfers, and Russian GDP further complicates the issue of the impacts of these indicators on Armenian GDP.

Table 3.2.1.2. Contemporaneous Correlations between the Index of Armenian GDP and the Indices of Selected Macroeconomic Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real industrial production</td>
<td>0.454</td>
</tr>
<tr>
<td>Real dram/ruble exchange rate</td>
<td>0.334</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>0.455</td>
</tr>
<tr>
<td>Real retail trade</td>
<td>0.392</td>
</tr>
<tr>
<td>Freight transportation</td>
<td>0.522</td>
</tr>
<tr>
<td>Merchandise exports</td>
<td>0.408</td>
</tr>
<tr>
<td>Merchandise imports</td>
<td>0.535</td>
</tr>
</tbody>
</table>

Table 3.2.1.1 shows that of the four indicators only labor income had a substantial contemporaneous correlation with Armenian GDP. Government transfers, both contemporaneous and lagged, were not substantially correlated with Armenian GDP. Contemporaneous private transfers and Russian GDP were not significantly correlated with Armenian GDP either, but correlation becomes relatively high when these indicators are taken with lags. At the same time, Table 3.2.1.2 demonstrates that many monthly indicators had a relatively strong contemporaneous correlation with Armenian GDP.

The following sub-section extends this analysis and shows that multi-variable high-frequency models may be better suited for short-term forecasting than simple single-variable models, even though these single variables may be highly important. Specifically, it predicts the slowdown of economic expansion in 2004 despite an acceleration of the growth of private transfers as well as continued strong growth of labor income and Russian GDP.
3.2.2. Armenian National Account Component and Aggregate GDP Forecasts

This section provides an overview of the selection of forecasting regressions for real GDP, nominal GDP, the GDP deflator, and the elements of real GDP – overall 14 variables. Each GDP component sub-section below describes the size of the component relative to total GDP, its correlation with GDP, and its relationship to the corresponding "special" indicator, if applicable.

The largest GDP component is household consumption (see Table 3.2.2.1). The accuracy of the forecast of this variable is especially important for total GDP forecasting.

<table>
<thead>
<tr>
<th>Table 3.2.2.1. Armenia: Shares of GDP Components in Total GDP, %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production</strong></td>
</tr>
<tr>
<td>Industrial value-added</td>
</tr>
<tr>
<td>Construction value-added</td>
</tr>
<tr>
<td>Agricultural value-added</td>
</tr>
<tr>
<td>Trade value-added</td>
</tr>
<tr>
<td>Transportation value-added</td>
</tr>
<tr>
<td>Other services value-added</td>
</tr>
<tr>
<td>Net taxes on products and imports</td>
</tr>
<tr>
<td><strong>Expenditures</strong></td>
</tr>
<tr>
<td>Household consumption</td>
</tr>
<tr>
<td>Government consumption</td>
</tr>
<tr>
<td>Investment</td>
</tr>
<tr>
<td>Net exports of goods and services</td>
</tr>
</tbody>
</table>

Notes: The shares of the production-side and expenditure-side components are calculated with respect to real production-side GDP in 2003 prices. Data for 2004 are not provided in the table since the historical sample ends in the third quarter of 2004, and the shares for the first three quarters would not be comparable with the annual shares because of seasonality.

Armenian GDP components are more difficult to forecast than Russian GDP components. First, GDP components in Armenia are not as strongly correlated with total GDP as they are in Russia. At the same time, as in Russia, most monthly indicators describe economic
conditions in general and are not directly linked to a forecasted national account component. Second, the dynamics of GDP components are not as close to the dynamics of the respective “special” indicators as they are in Russia. Third, the fluctuations of national account variables, both in levels and in indices, are wider than in Russia.

Table 3.2.2.2. Armenian National Account Growth Rates, Official Figures and Current-Quarter Out-of-Sample Forecasts, %

<table>
<thead>
<tr>
<th>Regression</th>
<th>Official index</th>
<th>Forecasted index</th>
<th>Margin of error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2004Q2</td>
<td>2004Q3</td>
<td>2004Q2</td>
</tr>
<tr>
<td>GDP - direct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>2.1</td>
<td>6.35</td>
<td>-2.15</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>3.1</td>
<td>7.94</td>
<td>14.53</td>
</tr>
<tr>
<td>Agricultural value-added</td>
<td>4.1</td>
<td>8.95</td>
<td>21.51</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>N/A</td>
<td>10.96</td>
<td>8.46</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>6.1</td>
<td>15.59</td>
<td>18.89</td>
</tr>
<tr>
<td>Other services value-added</td>
<td>7.1</td>
<td>22.76</td>
<td>4.34</td>
</tr>
<tr>
<td>Net taxes on prod's and imp's</td>
<td>8.1</td>
<td>0.81</td>
<td>5.82</td>
</tr>
<tr>
<td>GDP - production side</td>
<td>10.21</td>
<td>11.41</td>
<td>10.12</td>
</tr>
<tr>
<td>Household consumption</td>
<td>9.1</td>
<td>9.60</td>
<td>11.70</td>
</tr>
<tr>
<td>Government consumption</td>
<td>10.1</td>
<td>12.00</td>
<td>17.60</td>
</tr>
<tr>
<td>Investment</td>
<td>11.1</td>
<td>9.20</td>
<td>8.90</td>
</tr>
<tr>
<td>Net exports of goods and services</td>
<td>12.1</td>
<td>-11.90</td>
<td>-10.80</td>
</tr>
<tr>
<td>GDP - expenditure side</td>
<td>15.14</td>
<td>15.46</td>
<td>16.04</td>
</tr>
<tr>
<td>Nominal GDP - direct</td>
<td>14.1</td>
<td>16.97</td>
<td>20.31</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>13.1</td>
<td>6.14</td>
<td>7.99</td>
</tr>
<tr>
<td>GDP - nominal approach</td>
<td>10.21</td>
<td>11.41</td>
<td>9.36</td>
</tr>
<tr>
<td>GDP - average</td>
<td>11.44</td>
<td>12.42</td>
<td>11.51</td>
</tr>
</tbody>
</table>

Note: Because of the substantial statistical discrepancy, the growth rates of total GDP calculated as the sum of the production-side components differ significantly from the growth rates of GDP calculated as the sum of the expenditure-side components.

As we can see from Table 3.2.2.2, most of the selected complex regressions – containing principal components, “special” indicators, and other right-hand-side variables as discussed in Chapter 1 – produce very accurate or just accurate current-quarter forecasts
for both the second and the third quarters of 2004. Only three regressions – for total GDP, household consumption, and the GDP deflator – produce very accurate forecasts for both quarters. The forecasts of other services value-added and net exports of goods and services are border-line accurate for one of the two quarters. As in Russia, the most accurate (on balance) current-quarter total GDP forecasts are generated by using the direct and production-side approaches. Although some forecasts of total GDP are just accurate, the margin of error of the forecast calculated as the average of the forecasts obtained through the four approaches is below 0.1 percentage point, within the “very accurate” range, for both quarters. On balance, the average GDP forecasts for Armenia are even more accurate than for Russia.

Table 3.2.2.3. Armenian National Account Growth Rates, Official Figures and Next-Quarter Out-of-Sample Forecasts, %

<table>
<thead>
<tr>
<th>Regression</th>
<th>Official Index</th>
<th>Forecasted Index</th>
<th>Margin of error</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP - direct</td>
<td>1.1</td>
<td>11.41</td>
<td>11.68</td>
</tr>
<tr>
<td>Industrial value-added</td>
<td>2.1</td>
<td>-2.15</td>
<td>-2.15</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>3.1</td>
<td>14.53</td>
<td>14.79</td>
</tr>
<tr>
<td>Agricultural value-added</td>
<td>4.1</td>
<td>21.51</td>
<td>21.73</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>5.1</td>
<td>8.46</td>
<td>7.80</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>6.1</td>
<td>18.89</td>
<td>20.15</td>
</tr>
<tr>
<td>Other market services value-added</td>
<td>7.1</td>
<td>4.34</td>
<td>4.94</td>
</tr>
<tr>
<td>Net taxes on prod's and imp's</td>
<td>8.1</td>
<td>5.82</td>
<td>5.96</td>
</tr>
<tr>
<td>GDP - production side</td>
<td>11.41</td>
<td>11.62</td>
<td></td>
</tr>
<tr>
<td>Household consumption</td>
<td>9.1</td>
<td>11.70</td>
<td>11.30</td>
</tr>
<tr>
<td>Government consumption</td>
<td>10.1</td>
<td>17.60</td>
<td>17.78</td>
</tr>
<tr>
<td>Gross fixed investment</td>
<td>11.1</td>
<td>8.90</td>
<td>9.12</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>12.1</td>
<td>-10.80</td>
<td>-11.51</td>
</tr>
<tr>
<td>GDP - expenditure side</td>
<td>15.46</td>
<td>15.31</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP - direct</td>
<td>14.1</td>
<td>20.31</td>
<td>20.57</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>13.1</td>
<td>7.99</td>
<td>7.75</td>
</tr>
<tr>
<td>GDP - nominal approach</td>
<td>11.41</td>
<td>11.89</td>
<td></td>
</tr>
<tr>
<td>GDP - average</td>
<td>12.42</td>
<td>12.63</td>
<td></td>
</tr>
</tbody>
</table>
We can see from Table 3.2.2.3 that the one-quarter-ahead forecasts for the third quarter of 2004 are very accurate with one exception. The forecast of transportation value-added is just accurate. Unlike in the current-quarter case, the most accurate total GDP one-quarter-ahead forecasts are produced by the aggregation of the expenditure-side components. The average of the total GDP forecasts obtained through the four approaches is slightly less accurate than the average of the two-step one-quarter-ahead forecasts for Russia.

The official national account data are located within the plus/minus one standard deviation confidence interval estimated on the basis of out-of-sample forecasts generated by all of the selected complex regressions. If a national account variable has a "special" indicator, the forecast margin of error is less than the discrepancy between the official index of the national account variable and the official index of its "special" indicator for both the second and the third quarters of 2004 with one exception. The current-quarter model was not built for trade value-added because the index of this variable became very close to the index of retail trade, its “special” indicator, at the end of the period under consideration. The official index of retail trade can be applied as the current-quarter estimate of the trade value-added index. The confidence interval criterion is not discussed in the text below. Neither is the "special" indicator criterion, with the exception of the trade value-added case.

For many national account variables, the forecasts produced by the complex regressions are more accurate for both quarters than the forecasts produced by single-variable regressions. On several occasions, for one quarter, the forecast provided by a simple regression is more accurate than the forecast obtained through a complex regression. However, with one exception, even in such cases, on balance, for the two quarters, the former forecasts are less accurate than the latter. It was found that the best out-of-sample forecasts of transportation value-added are generated by an ARMA equation that does not

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43 The indicators selected for single-variable regressions of real national account components were the “special” indicators, labor income, government transfers, current transfers, lagged Russian GDP, and, occasionally other indicators.
include any principal components, "special" indicators, or other independent variables. Unless otherwise indicated, it should be assumed that the complex regression forecasts are more accurate than the simple regression forecasts. Also, in most cases the adjusted R-squared for a selected complex regression is greater than the adjusted R-squared for the selected single-variable regressions.

Special attention was paid to the testing of whether the linking of the Russian high-frequency model to the Armenian high-frequency model through the introduction of contemporaneous Russian GDP in the selected complex Armenian regressions would improve the forecast of the Armenian national account variables. Contemporaneous Russian GDP was also entered in the regressions applied to project the contemporaneous explanatory variables (principal components, etc.) from national account regressions. Although the coefficient of contemporaneous Russian GDP is statistically significant in many regressions, the application of this variable makes the forecasts of Armenian national account variables, on balance, less accurate. This is not surprising in light of the low correlation of the contemporaneous Russian GDP index with the index of Armenian GDP (see Table 3.2.1.1) and the indices of many other Armenian national account variables. Thus, knowledge of Russian GDP is not helpful in the current-quarter forecasting of Armenian GDP. At the same time, Russian GDP plays a substantial role in determining some of the Armenian national account variables with a lag.

As in the description of the Russian model, residual tests are mentioned below only when there appears to be a problem.

Regression specifications and outputs and forecast summary tables for the Armenia model are provided in Appendix B.

GDP. The selection of monthly indicators – overall 16 – used for the extraction of principal components for Armenian real GDP (RGDP) regressions followed the principles described in Section 1.1 for Russian GDP equation principal components. Regression 1.1 includes the first three principal components, which jointly explain 78.4%
of the variance in the original indicators, the second quarter intercept dummy variable, and lagged GDP. The adjusted R-squared of 0.998 shows that this regression provides an excellent fit of the data.

\[
\text{RGDP} = C(1) + C(2)\text{DUMMY2} + C(3)\text{RGDP(-2)} + C(4)\text{RGDP(-4)} + C(5)\text{PC1} + C(6)\text{PC2} + C(7)\text{PC3} + [\text{MA(6)=C(8)}] \quad (1.1)
\]

After the reduction of the sample by two quarters and the re-estimation of Regression 1.1 based on the reduced sample, the values of GDP were forecasted using the official values of monthly indicators for the out-of-sample period – the second and the third quarters of 2004. The forecast margins of error equaling 0.29 percentage point for the second quarter and 0.15 percentage point for the third quarter were within the “very accurate” range.

Figure 3.2.2.1. Armenia: GDP, Quarterly Year-Over-Year Indices

Of the signs of the partial derivatives of GDP with respect to the monthly indicators, only the positive sign of the derivative with respect to merchandise imports appears counterintuitive. The problem is that imports enter the GDP final expenditure identity
with the negative sign. However, Regression 1.3, which does not include any independent variables other than imports, confirms the positive contemporaneous relationship between imports and GDP. The correlation between the contemporaneous import and GDP indices is also positive. This may be a result of a positive impact of imports on consumption and investment, as a large portion of consumption and investment demand can be satisfied only with imported goods. A similar relationship was observed in Russia (see Section 3.1). At the same time, the coefficient of imports lagged four quarters in Regression 1.3 is negative, possibly showing that, in the long run, imports hurt domestic producers.

None of the estimated single-variable regressions produces a very accurate current-quarter out-of-sample forecast of GDP for either of the two quarters. One regression – with labor income (1.4) – generates accurate forecasts for both quarters. The forecasts provided with the regressions on imports and lagged Russian GDP (1.7) are accurate for one quarter and border-line accurate for the other quarter. The regressions on government transfers (1.5) and private transfers (1.6) generate accurate forecasts for one quarter and inaccurate forecasts for the other quarter. Finally, the forecast obtained through the regression on industrial production (1.2) is border-line accurate for one quarter and inaccurate for the other quarter.

Regression 1.1 also provides a very accurate one-quarter-ahead out-of-sample forecast when the principal components are themselves projected for the third quarter of 2004. The margin of error is 0.27 percentage point.

The coefficient for contemporaneous Russian GDP entered into Regression 1.1 is statistically insignificant. When this variable is entered into the regression used to project PC3 (1.10), the LM test indicates the presence of serial correlation in the residuals. The introduction of contemporaneous Russian GDP in the regressions applied to project PC1

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44 The coefficient for government transfers is negative. It is possible that foreign government financial assistance leads to misallocation of resources in Armenia. Another explanation is that donor agencies can anticipate changes in economic growth and decrease assistance when they foresee GDP growth acceleration.
and PC2 (1.11 and 1.12, respectively) results in less accurate forecasts of these principal components, and the forecast of Armenian GDP becomes inaccurate.

One of the monthly indicators from which the principal components for Regression 1.1 are extracted is Russian industrial production. The regressions of the other monthly indicators on Russian industrial production and the partial derivatives of Armenian GDP with respect to the monthly indicators obtained from Regression 1.1 allow for an estimation of the contemporaneous impact of Russian industrial production on Armenian GDP through these monthly indicators. It is very small – an increase in Russian industrial production by 1% leads to an increase in Armenian GDP by a mere 0.06%. The direct contemporaneous impact of Russian industrial production on Armenian GDP, calculated with the use of the partial derivative of Armenian GDP with respect to Russian industrial production, is even smaller – 0.01% if the latter rises by 1%. This is consistent with the previously made results showing that the contemporaneous impact of Russian GDP on Armenian GDP is negligible.

*Industrial Value-Added.* Industry is the second largest sector in the Armenian economy. It accounted for 19.9% of GDP in 2003, down from 22.0% in 1997. The correlation coefficient between the GDP index and the industrial value-added index, 0.66, was higher than the correlation coefficient between the GDP index and any other GDP component index.

The “special” indicator for industrial value-added is industrial production. The average absolute value of the difference between the industrial value-added index and the industrial production index in Armenia was 4.8 percentage points, much more significant than in Russia, though not as substantial as the discrepancies between most of the indices of other national account variables and the indices of their respective “special” indicators. The correlation coefficient between the industrial value-added and industrial production indices was 0.74, quite high. It appears that the two indices somewhat converged toward the end of the historical sample. In 2003-2004, the discrepancy did not exceed four percentage points.
Regression 2.1 of industrial value-added (RINDVA) on industrial production (RIND) and principal components generates an accurate current-quarter out-of-sample forecast for the second quarter of 2004 and a very accurate forecast for the third quarter with the higher margin of error of 1.09 percentage points.

\[
\text{RINDVA} = \beta_1 + \beta_2 \text{RINDVA}(-4) + \beta_3 \text{RIND} + \beta_4 \text{RIND}(-1) + \beta_5 \text{PC2} + \beta_6 \text{PC4} + \beta_7 \text{PC6} + [\text{AR}(1)=\beta_8, \text{MA}(6)=\beta_9] 
\]  

\text{(2.1)}

For at least one quarter of the two, a current-quarter out-of-sample forecast generated with a single-variable regression is inaccurate. At the same time, for one quarter, the regression on private transfers (2.5) provides a very accurate forecast, the regressions on
lagged Russian GDP (2.3) and labor income (2.6) provide accurate forecasts, and the regression on government transfers (2.4) provides a borderline accurate forecast.

Regression 2.1 also generates a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.002 percentage point for the third quarter of 2004 when the contemporaneous independent variables are themselves forecasted.

The coefficients for contemporaneous Russian GDP introduced in Regression 2.1 and in two regressions applied to project contemporaneous explanatory variables from Regression 2.1 are statistically insignificant. The introduction of contemporaneous Russian GDP in another regression that is used to project a contemporaneous independent variable from Regression 2.1 results in unsatisfactory residual properties. Finally, the use of the PC4 projection obtained through Regression 2.11, which contains contemporaneous Russian GDP, rather than the projection obtained through the regression of PC4 that does not include contemporaneous Russian GDP (2.9) results in a substantial increase in the margin of error of the industrial value-added forecast.

*Construction value-added.* Construction was the fastest growing sector during the period under consideration. In 2003, construction value-added stood at 15.5% of GDP, twice the 1997 share. Construction value-added growth was especially strong in 2002 and 2003, 41.5% and 44.5%, respectively. The correlation coefficient between the GDP index and the construction value-added index was 0.57, relatively high.

The average absolute value of the difference between the construction value-added and construction activity indices was quite high, 8.6 percentage points, but this was mostly due to outliers in 1998. Similar to the gap for industry, this discrepancy for construction narrowed toward the end of the historical sample, and in 2003-2004, it was, on average, only 1.4 percentage points. The correlation between the two indices estimated for the whole sample was 0.35, not very high.
Regression 3.1 of construction value-added (RCONSTRVA) on construction (RCONSTR) and principal components produces a very accurate current-quarter-out-of-sample forecast for the second quarter of 2004 and an accurate forecast for the third quarter. The higher margin of forecast error is 0.93 percentage point.

\[ RCONSTRVA = C(1) + C(2) \times DUMMY3 + C(3) \times RCONSTR + C(4) \times RCONSTR(-3) + C(5) \times RCONSTR(-4) + C(6) \times PC9 + C(7) \times PC1(-1) + C(8) \times PC1(-3) + C(9) \times PC9(-4) \]  

(3.1)

Figure 3.2.2.3. Armenia: Construction Value-Added and Construction, Quarterly Year-Over-Year Indices

If the principal components are not included (Regression 3.2), the forecasts become inaccurate. Since the discrepancy between the construction value-added and construction indices was especially significant at the beginning of the period under consideration, it is not surprising that the margin of error substantially declines if Regression 3.2 is estimated.
on the basis of the sample that begins in the first quarter of 1998 (before adjustment for lags in the independent variable) (Regression 3.3). In fact, the margin of error of the forecast generated by Regression 3.3 for the third quarter of 2004 is 0.92, slightly less than the margin of error obtained from Regression 3.1. On the other hand, the second-quarter forecast is much more accurate when produced by Regression 3.1 than by Regression 3.3. Therefore, Regression 3.1 is selected for construction value-added forecasting. The reduction of the historical sample by one more year at the beginning of the sample worsens the forecasts.

Other single-variable regressions produce only inaccurate forecasts. These regressions substantially overestimate construction value-added growth, i.e., they are not capable of forecasting the significant slowdown of construction value-added growth that occurred last year.

Regression 3.1 generates a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.26 percentage point when its contemporaneous independent variables are themselves projected.

The use of contemporaneous Russian GDP does not help forecast Armenian construction value-added. The coefficients for contemporaneous Russian GDP introduced in Regression 3.1 and in Regression 3.9, which is applied to project one of the two contemporaneous independent variables from Regression 3.1, are statistically insignificant. The introduction of contemporaneous Russian GDP in Regression 3.8, which is used to project the other contemporaneous independent variable from Regression 3.1, results in the presence of serial correlation in the residuals.

Contrary to widespread views, officially reported labor income may not have an impact on construction value-added. The coefficients for labor income, either lagged or contemporaneous, are statistically insignificant if, for example, labor income replaces private transfers in Regression 3.5. This may mean, for example, that official statistics significantly underestimate labor income as the IMF noted (see Section 3.2.1).
Agricultural Value-Added. This is the largest sector in Armenia, although its share in GDP substantially declined during the period under consideration. In 2003, it stood at 21.3%, down 4.5 percentage points from 1997. Despite the role of agriculture in the economy, the correlation between the index of agricultural value-added and the GDP index was a relatively small 0.26. The correlation between the index of agricultural value-added and the index of agricultural production, its “special” indicator, was 0.39, not very high either. The average absolute value of the difference between the two indices was 15.3 percentage points, quite substantial, although toward the end of the period under consideration this discrepancy significantly narrowed.

Figure 3.2.2.4. Armenia: Agricultural Value-Added and Agricultural Production, Quarterly Year-Over-Year Indices

Regression 4.1 on agricultural production (RAGR), private transfers (PT), lagged Russian GDP (RUSGDP), and principal components provides accurate current-quarter out-of-sample forecasts of agricultural value-added (RAGRVA) with the higher margin of error of 0.69 percentage point. The forecasts produced by the single-variable regressions are
inaccurate for at least one quarter of the two. Regression 4.6 on lagged Russian GDP generates a very accurate forecast for the second quarter of 2004, but, on balance, for the two quarters, Regression 4.1 produces more accurate forecasts. The adjusted R-squared is also a little higher for Regression 4.1 than for Regression 4.6. Regression 4.5 on private transfers generates an accurate forecast for the second quarter.

\[
\text{RAGRVA} = C(1) + C(2)\text{DUMMY1} + C(3)\text{DUMMY2} + \\
C(4)\text{DUMMY3} + C(5)\text{RAGR} + C(6)\text{PC1} + C(7)\text{PC9} + \\
C(8)\text{PT(-1)} + C(9)\text{RUSGDP(-3)} + [\text{AR(1)}=C(10)]
\] (4.1)

Regression 4.1 generates a very accurate forecast for the third quarter of 2004 when the contemporaneous explanatory variables are themselves forecasted. The margin of error is 0.22 percentage point.

The current-quarter out-of-sample forecasts of agricultural value-added become inaccurate when contemporaneous Russian GDP is introduced in Regression 4.1 (see Regression 4.7). The coefficient for contemporaneous Russian GDP is statistically insignificant if this variable is introduced in Regression 4.8, which is applied to project agricultural production. If contemporaneous Russian GDP is entered into Regression 4.10, which is used to project PC9, the LM test indicates the presence of serial correlation in the residuals. The introduction of this variable in the regression applied to project PC1 (4.11) results in a less accurate one-quarter-ahead out-of-sample forecast of PC1. This, in turn, leads to an increase in the margin of error of the agricultural value-added forecast to 0.99 percentage point when the new projected value of PC1 is entered into Regression 4.1.

*Trade Value-Added.* This sector includes retail trade, wholesales trade, and catering. It grew steadily during the period under consideration, but remained medium-sized. In 2003, its share in GDP stood at 10.7%, up two percentage points from 1997. The correlation between the trade value-added index and the GDP index was 0.46, average by Armenian standards. Surprisingly, the correlation coefficient between trade value-added
index and the agricultural value-added was −0.20, although this negative correlation can, to some extent, be explained by a lag between agricultural production and trade.\textsuperscript{46} Even more surprising was the fact that the correlation between the trade value-added index and the household consumption index was a mere 0.02. This may signal either the poor quality of national accounts data and/or the dominant role of unrecorded trade activity.

\textit{Figure 3.2.2.5. Armenia: Trade Value-Added and Retail Sales, Quarterly Year-Over-Year Indices}

At the same time, trade value-added significantly correlated with retail trade – the correlation coefficient between the indices of the two variables was 0.63. The absolute value of the difference between the two indices was a relatively low 3.78, on average, although in several quarters, this discrepancy was in double-digits. It narrowed toward the end of the period under consideration. In 2003 and 2004, it equaled 0.48, on average,

\textsuperscript{46} The share of imported food in the domestic food market is not very high.
and in the final two quarters of the historical sample, it did not exceed a quarter of a percentage point. The relatively small difference between the trade value-added and retail trade indices during the period under consideration partly results from the fact that nominal wholesale trade value-added equaled only about 4% of nominal retail trade and catering value-added. However, the minor role of wholesale trade does not explain the narrowing of the discrepancy, since the share of wholesale trade stood virtually unchanged.

Because the discrepancy became so small, it may be possible to forecast trade value-added with the margin of error within the “very accurate” range using full-quarter official retail trade figures. Therefore, for this GDP component, it was decided not to construct a current-quarter model, but to build a one-quarter-ahead model instead.

Regression 5.1 of trade value-added (RTRADEVA) on principal components provides an accurate one-quarter-ahead out-of-sample forecast with the margin of error 0.66.

\[
\text{RTRADEVA} = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times PC1(-1) + C(6)\times PC1(-4) + \left[\text{MA}(4)=C(7)\right] \tag{5.1}
\]

*Transportation and Communication Value-Added.* This is by far the smallest of the production-side sectors. Moreover, its share in GDP declined during the period under consideration. In 2003, it stood at 5.9%, down from 7.6% in 1997. The sector’s dynamics were highly erratic, showing relatively little correlation with dynamics observed in the economy as a whole and in many other sectors. In fact, the correlation of 0.23 between the GDP and transportation value-added indices was the smallest of the correlations between the GDP index and the index of any GDP component. Also, surprisingly, this sector’s value-added was negatively correlated with industrial and construction value-added – the correlation coefficients between the transportation value-added and the two respective indices were -0.06 and -0.15. Similarly puzzling was the lack of correlation with the trade value-added index – the correlation coefficient equaled precisely 0.00.

\[47\] This breakdown is not available in real terms,

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Freight transportation measured in ton-kilometers is the logical candidate for the transportation value-added “special” indicator. The correlation coefficient between the indices of freight transportation and transportation value-added was a relatively high 0.57. However, the difference between the two indices was also quite substantial, probably because freight transportation growth was much more volatile than the growth of transportation value-added. The average absolute value of the difference was 19.6 percentage points, and once (in the second quarter of 2003), the difference reached 73 percentage points. The breakdown of total freight transportation by mode of transportation does not allow for singling out a mode whose growth would closely resemble the growth of transportation value-added.

At the same time, the sector followed a highly seasonal pattern, with a regular sharp drop in the second quarter of each year, apparently, due to low demand for heat and low
agricultural production.\textsuperscript{48} Therefore, it is not surprising that while relatively precise current-quarter out-of-sample forecasts can be provided by an ARMA equation with a seasonal dummy and a lagged dependent variable (6.1), the introduction of freight transportation indicators, principal components, or other variables results in a decrease in the margin of forecast error, although the coefficients of these variables may be significant.

Regression 6.1 generates a very accurate current-quarter out-of-sample forecast of transportation value-added (RTRANSPVA) for the second quarter of 2004 and an accurate forecast for the third quarter with the higher margin of error of 0.88 percentage point. The regression on freight transportation (6.2) generates an accurate forecast of transportation value-added for one quarter, while for the other quarter the forecast is inaccurate. The rest of the estimated single-variable regressions provide inaccurate forecasts for both quarters.

\begin{equation}
\text{RTRANSPVA} = C(1) + C(2)\cdot\text{DUMMY2} + C(3)\cdot\text{RTRANSPVA}(-2) + \\
[\text{AR(1)}=C(4),\text{MA(4)}=C(5)]
\end{equation}

(6.1)

The introduction of contemporaneous Russian real GDP in Regression 6.1 (see Regression 6.7) results in an increase of the adjusted R-squared and an improvement in the accuracy of the third-quarter forecast. However, the forecast for the second quarter becomes inaccurate, and on balance, the current-quarter out-of-sample forecasts provided by Regression 6.1 are more accurate than those obtained through Regression 6.7. The sign of Russian GDP in Regression 6.7 is negative, which appears counterintuitive.

Since Regression 6.1 does not include any contemporaneous independent variables, no extra steps are needed to produce one-quarter-ahead out-of-sample forecasts.

\textit{Other Services Value-Added.} This is the third largest sector in Armenia. Its share in GDP declined uninterruptedly during the period under consideration, and in 2003, it stood at

\textsuperscript{48} Pipeline transportation represents an overwhelming portion of freight transportation.
17.6%, down three percentage points from 1997. The sector’s dynamics were weakly correlated with the dynamics of the economy as a whole – the correlation coefficient between the other services value-added index and the GDP index was only 0.32.

**Figure 3.2.2.7. Armenia: Other Services Value-Added, Consumer Spending on Goods and Services, and Paid Consumer Services, Quarterly Year-Over-Year Indices**

In the Russian model, paid consumer services and per capita consumer spending on goods and services were considered for the role of "special" indicator for other market services value-added, and the former was actually selected. In the Armenian model, consumer spending on goods and services appears statistically preferable to paid consumer services for the role of "special" indicator for other services value-added. 49 The average absolute value of the difference between the index of other services value-added and the index of consumer spending on goods and services was 6.4 percentage points,

49 Unlike in the Russian model, this variable also includes non-market services.
more than two percentage points less than the average discrepancy between the other services value-added and paid consumer services indices. Also, the correlation coefficient for the former pair of indices was substantially higher than the correlation coefficient for the latter pair, 0.53 versus 0.37.

An analysis of current-quarter out-of-sample forecasts shows that the most accurate forecasts of other services value-added (ROTHVA) are generated by Regression 7.1 on principal components without a "special" indicator. Both consumer spending on goods and services and paid consumer services are included in the set of monthly indicators used for the extraction of the principal components that are, in turn, applied in Regression 7.1. The other services value-added forecast is very accurate for the second quarter of 2004, but only border-line accurate for the third quarter. The higher margin of error is 1.58 percentage points. According to the official data, the growth of other services value-added plunged from 22.8% in the second quarter to 4.3% in the third quarter. The model forecasts a steep growth slowdown in the third quarter, though not as steep as the slowdown that the official figures reveal.

\[
ROTHVA = C(1) + C(2)*DUMMY2 + C(3)*ROTHVA(-4) + C(4)*PC1 + C(5)*PC4(-1) + C(6)*PC2(-4) + \{AR(1)=C(7),AR(2)=C(8),MA(2)=C(9)\} \quad (7.1)
\]

Two single-variable regressions – with consumer spending on goods and services (7.2) and with consumer services (7.3) – generate more accurate forecasts for the third quarter of 2004 than Regression 7.1. The Regression 7.2 forecast is border-line accurate and the Regression 7.3 forecast is very accurate. However, the second quarter forecasts produced by both Regression 7.2 and 7.3 are inaccurate, and, on balance, Regression 7.1 generates the most accurate forecasts of the three regressions. Regression 7.1 also has the highest adjusted R-squared. The other estimated single-variable regressions produce inaccurate forecasts for both quarters with one exception. The forecast obtained from Regression 7.5 on government transfers is inaccurate for one quarter, but border-line accurate for the other quarter.
Regression 7.1 also produces an accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal component is itself projected. The margin of error is 0.61 percentage point.

The coefficient of contemporaneous Russian GDP is statistically insignificant if this variable is entered into Regression 7.1 or Regression 7.8, which is applied to project the contemporaneous principal component from Regression 7.1.

Net Taxes on Products and Imports. This is the second smallest component of Armenian GDP studied here. Its share in GDP slowly rose during almost all of the period under consideration. In 2003, it stood at 9.1% of GDP, up from 7.8% in 1997. The correlation of the net tax index with the GDP index was a relatively low 0.35, and the correlation with the indices of many GDP components was negative. The government budget indicators, which are published by the NSS on a quarterly basis, as well as their combinations, do not seem to match this category of taxes from national accounts. At the same time, VAT and excise taxes, which fall under the category of taxes on products, proved useful in the forecasting of this variable.\(^{50}\)

Regression 8.1 on principal components, VAT (RVAT), excise taxes (REXCTAX), and lagged Russian GDP (RUSGDP) generates an accurate current-quarter out-of-sample forecast of net taxes on products and imports (RTAXPI) for the second quarter of 2004 and a very accurate forecast for the third quarter. The higher margin of error is 1.1 percentage points. The estimated single-variable regressions produce inaccurate forecasts for both quarters with two exceptions. The regression with labor income (8.4) and the regression with VAT (8.3) produce, respectively, an accurate forecast and a border-line accurate forecast for one quarter.

\(^{50}\) Nominal VAT and excise taxes were deflated by consumer prices to obtain the real figures.
Regression 8.1 also generates a very accurate forecast of net taxes with the margin of error of 0.14 when PC1, the only contemporaneous principal component, is itself projected.

The coefficient for contemporaneous Russian GDP introduced in Regression 8.1 is statistically insignificant. The introduction of this variable in the regression applied to project PC1 (8.9) results in a less accurate one-quarter-ahead out-of-sample forecast of PC1. This, in turn, leads to an increase in the margin of error of the net tax forecast to 1.19 percentage points when the new projected value of PC1 is entered into Regression 8.1.
**Household Consumption.** This is by far the largest of the Armenian GDP components considered in this study. In 1997, household consumption exceeded GDP by 10.9%. The share of household consumption in GDP plunged in 1998 and then substantially declined again at the end of the period under consideration. Nevertheless, the household consumption-to-GDP ratio remained high, equaling 83.6% in 2003. The correlation between the household consumption and GDP indices was 0.49, not very strong for a variable accounting for more than four-fifths of GDP.

*Figure 3.2.2.9. Armenia: Household Consumption and Consumer Spending on Goods and Services, Quarterly Year-Over-Year Indices*

A logical choice for the role of “special” indicator is consumer spending on goods and services. The absolute value of the difference between the indices of the two variables was 5.2 percentage points, but in several quarters, this discrepancy was in double-digits. The correlation between the two indices was a relatively low 0.28. In the Russian model, the volume of retail sales was another indicator considered for the role of “special”
indicator for household consumption. In the Armenian model, this choice would be clearly inferior to consumer spending. First, the average discrepancy between the indices of household consumption and retail sales was 7.6 percentage points, greater than for household consumption and consumer spending. Second, and most importantly, household consumption was negatively correlated with contemporaneous retail sales – the correlation coefficient between the two indices was –0.13.51

Regression 9.1, which includes consumer spending (RSPENGS) and principal components, produces very accurate current-quarter out-of-sample forecasts of household consumption (RHCONS) with the higher margin of error of 0.36 percentage point. A regression that includes only consumer spending, but no principal components, may have the same adjusted R-squared as Regression 9.1. However, forecasts become less accurate. For example, Regression 9.2 generates an accurate forecast for one quarter and an inaccurate forecast for the other.

RHCONS = C(1) + C(2)*DUMMY2 + C(3)*RHCONS(-4) + C(4)*RSPENGS + C(5)*PC3 + C(6)*PC1(-2) + C(7)*PC1(-3) + [AR(3)=C(8)]  

(9.1)

Of the other estimated single-variable regressions, the best forecasts are provided by the regression on industrial production (9.3) – for one quarter the forecast is very accurate and for the other it is just accurate. The forecasts generated by the regressions on government transfers (9.5) and private transfers (9.6) are accurate for one quarter and inaccurate for the other. The regression on labor income (9.4) produces inaccurate forecasts for both quarters.

Regression 9.1 also generates a very accurate one-quarter-ahead out-of-sample forecast of household consumption with the margin of error of 0.40 percentage point.

51 The household consumption index was positively correlated with the retail trade indices lagged two and three quarters, although the correlation was not very strong.
The introduction of contemporaneous Russian GDP in Regression 9.1 (see Regression 9.7) slightly improves the forecast for the second quarter of 2004, while the third-quarter forecast becomes just accurate. Also, the adjusted R-squared slightly declines. Thus, on balance, Regression 9.1 appears better than Regression 9.7. The coefficients of contemporaneous Russian GDP entered into the regressions applied to project the contemporaneous independent variables from Regression 9.1 (Regressions 9.8 and 9.9) are statistically insignificant.

*Government consumption.* The share of this sector in GDP declined uninterruptedly during the period under consideration. In 2003, it stood at 10.3%, down 3.5 percentage points from 1997. The correlation of the government consumption index with the GDP index was 0.43, a little lower than the correlation between the household consumption and GDP indices.

*Figure 3.2.2.10. Armenia: Government Consumption and Government Budget Expenditures, Quarterly Year-Over-Year Indices*
The special indicator for this variable is government budget expenditures. In real terms, budget expenditures were calculated by deflating current budget expenditures by consumer prices and capital expenditures by investment prices. The average absolute value of the difference between the index of government consumption and government expenditures was a high 15.2 percentage points. The discrepancy was especially substantial at the beginning of the period under consideration. At the same time, the correlation between the two indices was 0.46, i.e., it was not low. This probably reflects the fact that the wide fluctuations in government consumption were quite close to the fluctuations in government budget expenditures in the middle of the historical sample, as can be seen from Figure 3.2.2.10.

Regression 10.1, which includes government budget expenditures (RBEXP), private transfers (PT), the capital and financial account balance (CAPFIN), and a principal component, generates an accurate current-quarter out-of-sample forecast of government consumption (RGOVCONS) for one quarter and a very accurate forecast for the other quarter, with the higher margin of error equaling 1.16 percentage points.

\[
\begin{align*}
RGOVCONS &= C(1) + C(2) \times DUMMY1 + C(3) \times RGOVCONS(-1) + \\
&+ C(4) \times RBEXP + C(5) \times PC1(-3) + C(6) \times GT(-2) + C(7) \times CAPFIN(-2) + \\
&[MA(6)=C(8)]
\end{align*}
\] (10.1)

All of the estimated single-variable regressions provide inaccurate current-quarter out-of-sample forecasts of government consumption for both quarters. Also inaccurate are the forecasts produced by the regression that does not include government budget expenditures (10.7), despite the fact that the dynamics of government consumption were not very close to the dynamics of budget expenditures.

Regression 10.1 also generates a very accurate one-quarter-ahead out-of-sample forecast of government consumption when government budget expenditures, the only
contemporaneous variable in Regression 10.1, are themselves projected. The margin of error is 0.18 percentage point.

The coefficients of contemporaneous Russian GDP entered into Regression 10.1 and Regression 10.8, which projects government budget expenditures, are statistically insignificant.

Total Investment. The NSS does not publish the breakdown of real total investment into gross fixed investment and change in inventories. Total investment rose substantially during the period under consideration, reaching 24.7% in 2003, up from 20.3% in 1997. This variable was significantly correlated with overall economic activity – the correlation coefficient between the GDP index and the total investment index was 0.64. Of the correlations between the GDP index and the indices of GDP components, only the correlation between the GDP index and the industrial value-added index was more substantial.

The logical choice for the role of “special” indicator is the fixed investment indicator that the NSS releases monthly. The dynamics of total investment (national accounts) and fixed investment (“monthly” methodology) substantially varied during the period under consideration, especially in the beginning. The absolute value of the difference between the indices of these two variables was 19.6 percentage points, on average, and once it was in triple digits. At the same time, the coefficient between the total investment index and the fixed investment index was 0.48, not a low number.

Regression 11.1 of total investment (RINVNA) on fixed investment (RINVEST) and principal components produces a very accurate current-quarter out-of-sample forecast for one quarter and an accurate forecast for the other quarter. The higher margin of error is 0.66 percentage point. Regression 11.2, which includes only fixed investment as an independent variable, has a slightly higher adjusted R-squared than Regression 11.1, but the out-of-sample forecasts generated by this regression are inaccurate.
RINVNA = C(1) + C(2)*RINVNA(-4) + C(3)*RINVEST + C(4)*PC5 + C(5)*PC1(-1) + C(6)*PC8(-2) + C(7)*PC5(-3)  \hspace{1cm} (11.1)

*Figure 3.2.2.11. Armenia: Total Investment (National Accounts) and Fixed Investment (“Monthly” Methodology), Quarterly Year-Over-Year Indices*

Of the single-variable regressions, the regression on lagged Russian GDP (11.6) produces an accurate total investment forecast for one quarter and an inaccurate forecast for the other quarter. The other single-quarter regressions generate inaccurate forecasts for both quarters.

Regression 11.1 produces a very accurate one-quarter-ahead out-of-sample forecast when the contemporaneous independent variables are themselves projected. The margin of error is 0.22 percentage point.
The use of contemporaneous Russian GDP does not help forecast Armenian investment. The introduction of contemporaneous Russian GDP in Regression 11.1 (see Regression 11.7) slightly raises the adjusted R-squared, but the out-of-sample forecasts become substantially less accurate. Regressions 11.10 and 11.11 are obtained by the introduction of contemporaneous Russian GDP in the regressions that forecast the contemporaneous explanatory variables for Regression 11.1. The use of projections obtained through Regressions 11.10 and 11.11, instead of the projections obtained through the regressions that do not include contemporaneous Russian GDP (Regressions 11.8 and 11.9, respectively), results in a substantial increase in the margin of error of the one-quarter-ahead out-of-sample investment forecast.

*Net Exports of Goods and Services.* This variable was negative in all of the quarters of the period under consideration. Its share in GDP declined rapidly and almost uninterruptedly. In 2003, it stood at 17.9%, down from 34.2% in 1997. The index of net exports positively correlated with the GDP index, but the correlation coefficient was not very high – only 0.40. At the same time, the dynamics of net exports of goods and services were very close to the dynamics of its “special” indicator, net merchandise exports measured in U.S. dollars. The correlation between the indices of the two variables was 0.87. The average absolute value of the difference between these indices was, nevertheless, a significant 12.1 percentage points. The discrepancy widened toward the end of the period under consideration.

Regression 12.1 on net merchandise exports (NETEXP), net transportation services (TRANSPSERV), and a principal component generate a border-line accurate current-quarter out-of-sample forecast of net exports of good and services (RTB) for the second quarter of 2004. The third quarter forecast is very accurate. The higher margin of error is 1.57 percentage points.

\[
RTB = C(1) + C(2)*DUMMY2 + C(3)*NETEXP + C(4)*PC3 + C(5)*TRANSPSERV + C(6)*TRANSPSERV(-4) + [MA(6)=C(7)]
\] (12.1)
With one exception, the estimated single-variable regressions generate inaccurate current-quarter out-of-sample forecasts of net exports of goods and services for both quarters. Regression 12.4 on government transfers produces accurate forecasts for both quarters. In fact, the second-quarter Regression 12.4 forecast is more accurate than the Regression 12.1 forecast. However, the third-quarter forecast obtained through Regression 12.1 is much more accurate than that obtained through Regression 12.4. On balance, for the two quarters, the former regression produces more accurate forecasts than the latter. Also, the adjusted R-squared for Regression 12.1 is much greater than for Regression 12.4.

Regression 12.1 also produces an accurate one-quarter-ahead out-of-sample forecast when the contemporaneous explanatory variables are themselves projected. The margin of error is 0.71 percentage point.
The coefficients for contemporaneous Russian real GDP introduced in Regression 12.1, in the regression of net merchandise trade balance, and in the regression of net transportation services are statistically insignificant. If this variable is introduced in the regression for PC3, the Jarque-Bera statistic shows that the residuals are not normally distributed.

**GDP deflator.** The dynamics of the GDP deflator were close to the dynamics of consumer prices. The correlation coefficient between the index of the GDP deflator and the consumer price index was 0.87, and the average absolute value of the difference between the two indices was 2.1 percentage points. This is not surprising in light of the fact that household consumption accounted for more four-fifths of GDP. Although other price indices, including the industrial producer price index and the agricultural producer price index, were also strongly correlated with the GDP deflator (the respective correlation coefficients equaled 0.73 and 0.65), the role of consumer prices in determining the GDP deflator appeared more important.

Nevertheless, regressions that include consumer prices as the “special” indicator do not appear to be able to produce, on balance, as accurate deflator (GDPDEFL) current-quarter out-of-sample forecasts as those generated by Regression 13.1 on principal components extracted from the set of monthly indicators that include consumer prices. The forecast obtained through Regression 13.1 are very accurate for both quarters with the higher margin of error equaling 0.15 percentage point.

\[
GDPDEFL = C(1) + C(2)\times DUMMY3 + C(3)\times GDPDEFL(-2) + C(4)\times PC1 + C(5)\times PC2 + C(6)\times PC3 + [MA(3)=C(7),MA(5)=C(8)]
\]  

(13.1)

The partial derivatives of the GDP deflator with respect to the monthly indicators are positive except for the derivatives with respect to real industrial production, real retail trade, and the nominal commercial bank interest rate (see Table 13.3 in the Appendix). Most of the partial derivatives of the GDP deflator with respect to monthly indicators have the signs that may be considered normal. The sign of a deflator partial derivative
with respect to a real production variable, such as real industrial production, can be either positive or negative.

Figure 3.2.2.13. Armenia: GDP Deflator, Consumer Prices, and Industrial Producer Prices, Quarterly Year-Over-Year Indices

The positive sign of the derivative with respect to imports is somewhat puzzling, since one may expect that rising imports increase the domestic supply of goods and, thus, should negatively affect prices. However, as imports are measured not in real terms, but in U.S. dollars, the positive influence of imports on the deflator may occur when imports rise largely as a result of an increase in the international prices of imported goods. Regression 13.7, a single-variable regression of the deflator on merchandise imports, confirms that imports may have a positive contemporaneous impact on the deflator.
It seems more counterintuitive that the rise in real retail trade inventories leads to an increase in the deflator, especially in light of the negative effect on the deflator of the rise in real retail trade. It is reasonable to expect that an increase in real inventories should exert downward pressure on prices, since it signals to suppliers that it becomes more difficult to sell accumulated goods. Nevertheless, Regression 13.6, with real retail trade inventories as a single explanatory variable, shows a strong positive impact of inventories on the deflator. The correlation between the indices of these two variables is also positive (0.27). Illustrating the importance of this indicator in determining prices, its elimination from the set of indicators from which the principal components are extracted or its replacement with nominal inventories reduces out-of-sample deflator forecast accuracy.

The current-quarter out-of-sample forecast of the deflator produced by the single-variable regression with consumer prices (13.2) is very accurate for the second quarter of 2004. In fact, its margin of error is exactly the same as the margin of error of the forecast generated by Regression 13.1. Also, the adjusted R-squared for Regression 13.2 is higher than for Regression 13.1. However, the Regression 13.2 third-quarter forecast is just accurate. The regression on industrial producer prices (13.2) also generates a very accurate forecast for one quarter and an accurate forecast for the other quarter. The regression on agricultural producer prices (13.4) provides just accurate forecasts for both quarters. The forecasts obtained through the regression on real retail trade inventories (13.6) and (13.7) merchandise imports are accurate for one quarter and inaccurate for the other quarter. Finally, the regression on freight transportation prices (13.5) produces inaccurate forecasts for both quarters.

Regression 13.1 also generates a very accurate one-quarter-ahead out-of-sample forecast for the third quarter when the principal components are themselves projected. The margin of error is 0.23 percentage point.

*Nominal GDP.* The nominal GDP index was more strongly correlated with the GDP deflator index than with the real GDP index – the respective correlation coefficients were
0.80 and 0.68. The high nominal GDP growth rates at the beginning of the historical sample corresponded to the period of highest inflation.

The partial derivatives of nominal GDP with respect to the monthly indicators are positive except for the derivatives with respect to the nominal dram/ruble exchange rate and the nominal commercial bank interest rate (see Table 14.3 in Appendix B). No partial derivative sign appears counterintuitive.

Figure 3.2.2.14. Armenia: Nominal GDP, Quarterly Year-Over-Year Indices

Regression 14.1 on principal components produces accurate current-quarter out-of-sample forecasts of nominal GDP (NGDP) for both quarters. The higher margin of error is 1.07 percentage points. All of the estimated single-variable regressions generate inaccurate current-quarter out-of-sample forecasts for at least one quarter of the two. Four regressions – on nominal agricultural production (14.2), nominal industrial production (14.3), nominal retail trade (14.4), and nominal M2 (14.5) – generate accurate forecasts for one quarter. In fact, the forecast for the third quarter of 2004 produced by Regression 14.2 is slightly more accurate than the forecast produced by Regression 14.1. However,
for both quarters, on balance, the Regression 14.1 forecasts are more accurate than the Regression 14.2 forecasts. Also, the adjusted R-squared is higher for Regression 14.1 than for Regression 14.2.

\[ \text{NGDP} = C(1) + C(2)\cdot\text{NGDP}(-1) + C(3)\cdot\text{NGDP}(-2) + C(4)\cdot\text{NGDP}(-4) + C(5)\cdot\text{PC1} + C(6)\cdot\text{PC2} + C(7)\cdot\text{PC3} + [\text{MA}(5)=C(8)] \quad (14.1) \]

Regression 14.1 also produces a very accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal components are themselves projected. The margin of error is 0.26 percentage point.
3.3. Czech Republic High-Frequency Model

3.3.1. Czech Republic Economic Growth and Its Factors

Like the economies of other transition countries, the Czech economy contracted during the first years of transition. This contraction was not, however, as deep as contractions in Russia and Armenia. The Czech economy bottomed out in 1992, when GDP equaled 87.9% of the 1990 level. It expanded through 1996, successfully withstanding separation with Slovakia in 1993. GDP declined again in 1997 and 1998, following the crisis of May 1997. Since 1999, the Czech economy has been growing uninterruptedly at a moderate pace. In 2004, GDP increased 4.0%, the highest growth rate in the post-crisis period, reaching 115.1% of the 1990 level. According to the World Economic Outlook (IMF, 2005a), in 2004, Czech per capita GDP stood at $17,367 in purchasing power parity (PPP) terms, the second highest level in Eastern Europe after Slovenia.

Inflation was in double-digits in the Czech Republic in the first half of the 1990s and, briefly, following the crisis. Unlike Russia and Armenia, the country never experienced triple-digit price growth, even at the early stages of market transformation.

Unlike Russia and, especially, Armenia, the economic problems that the Czech Republic is facing are related not so much to reducing poverty as to narrowing the gap with the average income level of the 15 countries that constituted the EU prior to 2004 (EU-15). In PPP terms, Czech per capita GDP equals about 63% of this level (IMF, 2004a). It is slightly below per capita GDP in Greece and Portugal, the poorest of the EU-15 countries. In 1996-2004, the period under consideration in this study, the gap with average EU income actually slightly widened. The Czech economy grew 2.1% per year, while the pre-expansion EU economies expanded at 2.2% per year. At the same time, the Czech economy grew faster than the economy of EU-15 in 2000-2004. Czech economic growth was also slower than growth in the other transition Central European countries.

\[52 \text{ In 1990, the first democratic parliamentary elections were held in Czechoslovakia since 1946. They followed the "velvet" revolution of November 1989.}\]
The Polish economy, for example, expanded at 4.1% a year in 1996-2004. Like many advanced countries, the Czech Republic is experiencing increasing pressure on the state budget – in particular, on the pension and health care systems – due to an aging population. However, because of the income gap, the country has fewer resources to cope with these problems than the EU-15 countries.

**Figure 3.3.1.1. Czech Republic: Annual Real GDP and Price Growth Rates (%)**

Unlike the Russian and Armenian economies, the Czech economy is not usually considered driven by just a few more or less easily measurable factors. The country's economic successes and failures have been generally attributed to economic reform, including market transformation and integration with the EU, which culminated in formal membership in this organization in May 2004.

Czech post-communist history shows that the assessment of reforms was not always correct. As a World Bank study notes, "until 1996, the Czech Republic was perceived as
the most successful transition economy in Central and Eastern Europe” due to rapid privatization, the relative mildness of the contraction at the beginning of transition, low unemployment, and a balanced government budget (World Bank, 1999, p.1). The success of the privatization program was reassessed because of the 1997 crisis, whose fundamental causes are believed to have included flawed and insufficient privatization, especially in the banking sector, and weak corporate governance. The fiscal, structural, and regulatory reforms introduced in 1997 have been credited for building the foundation of the economic expansion that resumed in 1999.

The openness of the Czech economy and its integration with Western economies have manifested themselves in the growth of foreign trade and investment. After the collapse of communist rule, the country quickly re-oriented its exports toward the developed world. In the 1980s, only 15% of Czechoslovak exports went to the highly industrialized market economies. By 1995, the share of these economies in Czech exports had risen to 60% (Stroehlein et al, 1999). In 2002, the EU accounted for 68.3% of Czech exports. Germany’s share was 36.4%. The re-orientation of foreign trade was accompanied by a rapid increase in trade volume. In 1995, exports of goods and services accounted for 50.7% of GDP. By 2004, they rose to 71.3%, as measured in current prices. In real terms, this increase was even more substantial (see Section 3.3.2). The share of imports also increased dramatically, from 55.0% to 71.7%.

Unlike Russia, with its reliance on oil, the Czech Republic does not have a single commodity that dominates its exports. In general, it specializes in manufacturing products of the middle level of sophistication. In 2004, motor vehicles accounted for 15.8% of total merchandise exports, more than any other major commodity group.

The Czech Republic has accumulated about $45 billion in foreign direct investment (FDI) since the beginning of market transformation. This amounts to $42% of the country’s 2004 GDP. Most FDI – 70.6% in 2004 – originated from the EU-15 countries. FDI is considered important for boosting the international competitiveness of Czech goods and stimulating domestic investment.
Despite the important role of EU-15, and, in particular, Germany, as a destination for Czech exports and a source of FDI in the Czech Republic, Czech GDP growth dynamics do not appear to be close to GDP growth dynamics in EU-15 or in Germany. We can see from Figure 3.3.1.2 that the Czech recession of 1997-1998 occurred when economic growth in EU-15 was quite strong. The recovery in 1999 and 2000 did, in fact, take place when EU-15 growth was also accelerating, and the subsequent slowdown of growth in the Czech Republic did correspond to the deceleration of economic expansion in EU-15. However, in 2003 and 2004, the Czech and EU-15 growth patterns clearly diverged, as growth in the Czech Republic markedly sped up, while growth in EU-15 accelerated just slightly.
Graphically, it is also difficult to see a common pattern in the movements of the Czech GDP index and the index of merchandise exports, despite a very high export-to-GDP ratio. Figure 3.3.1.3 shows, for example, that export growth accelerated in 1997, when the economy was in recession.

**Figure 3.3.1.3. Czech GDP and Merchandise Exports (in Euro), Quarterly Year-Over-Year Indices**

As can be seen from Table 3.3.1.1, the correlation between the Czech GDP index and the indices of GDP in EU-15 and Germany was negative, regardless of whether the latter two indices were taken contemporaneously with the Czech GDP index or were lagged. Similarly, the correlation between the Czech GDP index and the index of merchandise exports was also negative. The correlation of the Czech GDP index with the index of FDI inflow was negative up to lag order two. For the lags of higher order, the correlation was positive, though not very strong.
Table 3.3.1.1. Correlations between the Indices of Czech GDP and the Indices of EU-15 GDP, German GDP, Czech Merchandise Exports (in Euro), and FDI Inflow in the Czech Republic (in Euro)

<table>
<thead>
<tr>
<th>Lag, quarters</th>
<th>EU-15 GDP</th>
<th>German GDP</th>
<th>Merchandise exports</th>
<th>FDI inflow&lt;sup&gt;53&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-0.373</td>
<td>-0.086</td>
<td>-0.008</td>
<td>-0.494</td>
</tr>
<tr>
<td>1</td>
<td>-0.355</td>
<td>-0.050</td>
<td>-0.101</td>
<td>-0.314</td>
</tr>
<tr>
<td>2</td>
<td>-0.301</td>
<td>-0.027</td>
<td>-0.132</td>
<td>-0.146</td>
</tr>
<tr>
<td>3</td>
<td>-0.214</td>
<td>-0.023</td>
<td>-0.080</td>
<td>0.076</td>
</tr>
<tr>
<td>4</td>
<td>-0.129</td>
<td>-0.003</td>
<td>-0.070</td>
<td>0.173</td>
</tr>
<tr>
<td>5</td>
<td>-0.080</td>
<td>-0.004</td>
<td>-0.062</td>
<td>0.220</td>
</tr>
</tbody>
</table>

Table 3.3.1.2. Contemporaneous Correlations between the Index of Czech GDP and the Indices of Selected Macroeconomic Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real mining production</td>
<td>0.356</td>
</tr>
<tr>
<td>Real utilities production</td>
<td>0.412</td>
</tr>
<tr>
<td>Real construction</td>
<td>0.632</td>
</tr>
<tr>
<td>Real transportation sales</td>
<td>0.760</td>
</tr>
<tr>
<td>Real retail trade</td>
<td>0.776</td>
</tr>
<tr>
<td>Ratio of exports to imports</td>
<td>-0.749</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>-0.814</td>
</tr>
<tr>
<td>Real average industrial wage</td>
<td>0.564</td>
</tr>
<tr>
<td>Ratio of consumer prices to industrial producer prices</td>
<td>-0.641</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>-0.560</td>
</tr>
<tr>
<td>Business confidence index</td>
<td>0.614</td>
</tr>
</tbody>
</table>

At the same time, the indices of EU-15 and German GDP, on the one hand, were relatively strongly positively correlated with Czech real exports of goods and services and merchandise exports measured in euro, on the other hand. The problem is that

---

<sup>53</sup> The correlation of the Czech GDP index with the index of FDI inflow is calculated for the period between the first quarter of 1996 and the third quarter of 2003, when FDI inflow was consistently positive.
exports were negatively correlated with consumption, both personal and government, and manufacturing value-added.  

Figure 3.3.1.4. Czech Republic: Quarterly Real GDP and Prices (1995Q4 = 100)

Thus, in general, it appears that the above-mentioned external factors are not sufficient to explain economic growth short-term fluctuations. At the same time, correlation analysis shows that there are many monthly indicators whose changes signal changes in GDP (see Table 3.3.1.2).

Czech GDP and many of its components followed a seasonal pattern, as can be seen from Figure 3.3.1.4. GDP was usually the highest in the second quarter of a given year. However, the seasonal factor was not as strong in determining the fluctuations of Czech

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54 As mentioned before, Czech exports are dominated by manufacturing goods. Exports and manufacturing production are, in fact, positively correlated, while correlation between exports and manufacturing value-added is negative.
GDP as it was in determining the fluctuations of Russian GDP and, especially, Armenian GDP.

The following sub-section extends this analysis and shows that multi-variable high-frequency models may be better suited for short-term forecasting than simple single-variable models, even though these single variables may be highly important. Specifically, it predicts the relatively strong economic expansion in the second half of 2004, despite sluggish growth in EU-15 and Germany, in particular.

3.3.2. Czech National Account Component and Aggregate GDP Forecasts

This section provides an overview of the selection of forecasting regressions for real GDP, nominal GDP, the GDP deflator, and the elements of real GDP – overall 17 variables. Each GDP component sub-section below describes the size of the component relative to total GDP, its correlation with GDP, and its relationship to the corresponding "special" indicator, if applicable.

The largest GDP components considered in this study – exports of goods and services, imports of goods and services, and household consumption – are on the expenditure side (see Table 3.3.2.1). The accuracy of their forecasts is especially important for total GDP forecasting. In 1995 prices, exports approached total GDP, and imports exceeded GDP in 2004. The smallest element – consumption by non-commercial organizations serving households – is also on the expenditure side. The role of this variable in the forecasting of total GDP is almost negligible.

As in the Russian and Armenian models, most monthly indicators describe economic conditions in general and are not directly linked to a forecasted national account component. As in the Russian case, in the Czech model, there were several monthly indicators strongly correlated with GDP. Czech monthly indicators were clearly more

55 In current prices, the shares of these two variables in GDP were substantially below 100%.
strongly correlated with Czech GDP than Armenian monthly indicators with Armenian GDP.

At the same time, correlation between total GDP and its elements was not as strong for the Czech Republic as it was for Russia and Armenia. On average, the correlation coefficient between the GDP index and the index of its element equaled 0.29 in the Czech case. For Russia and Armenia, these correlations were, respectively, 0.58 and 0.44. Since many monthly indicators are not directly linked to the forecasted GDP element, weak correlation between a GDP element and total GDP may complicate the forecasting of this element.

Another problem for the Czech model is that the candidates for the role of “special” indicator were not so closely tied to the respective national account variables as they were for Russia and Armenia. Manufacturing production and retail trade were, in fact, negatively correlated with, respectively, manufacturing value-added and trade value-added in the Czech Republic.

Table 3.3.2.1. Czech Republic, Shares of GDP Components in Total GDP, %

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing value-added</td>
<td>21.6</td>
<td>23.9</td>
<td>25.0</td>
<td>22.9</td>
<td>25.5</td>
<td>25.7</td>
<td>24.2</td>
<td>26.5</td>
<td>27.6</td>
<td>28.5</td>
</tr>
<tr>
<td>Utilities value-added</td>
<td>5.0</td>
<td>5.3</td>
<td>4.8</td>
<td>3.9</td>
<td>3.6</td>
<td>4.3</td>
<td>3.4</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>8.6</td>
<td>7.2</td>
<td>6.4</td>
<td>6.7</td>
<td>5.2</td>
<td>5.0</td>
<td>4.4</td>
<td>4.5</td>
<td>4.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>10.6</td>
<td>10.3</td>
<td>12.0</td>
<td>13.6</td>
<td>14.0</td>
<td>14.4</td>
<td>15.3</td>
<td>14.0</td>
<td>14.4</td>
<td>14.2</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>9.7</td>
<td>9.4</td>
<td>9.1</td>
<td>9.0</td>
<td>9.2</td>
<td>8.6</td>
<td>9.2</td>
<td>9.6</td>
<td>8.5</td>
<td>8.4</td>
</tr>
<tr>
<td>Real estate value-added</td>
<td>11.9</td>
<td>10.6</td>
<td>10.2</td>
<td>11.3</td>
<td>11.2</td>
<td>11.7</td>
<td>12.6</td>
<td>11.6</td>
<td>12.1</td>
<td>11.8</td>
</tr>
<tr>
<td>Other sectors value-added</td>
<td>23.1</td>
<td>23.1</td>
<td>21.5</td>
<td>21.9</td>
<td>20.7</td>
<td>20.2</td>
<td>20.1</td>
<td>20.5</td>
<td>19.1</td>
<td>18.6</td>
</tr>
<tr>
<td>Net taxes on prod's and imp's</td>
<td>9.6</td>
<td>10.2</td>
<td>11.1</td>
<td>10.7</td>
<td>10.6</td>
<td>10.1</td>
<td>10.8</td>
<td>10.4</td>
<td>11.0</td>
<td>11.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenditures</th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Household consumption</td>
<td>49.4</td>
<td>51.6</td>
<td>52.7</td>
<td>52.5</td>
<td>53.0</td>
<td>52.5</td>
<td>52.6</td>
<td>53.3</td>
<td>53.9</td>
<td>53.9</td>
</tr>
<tr>
<td>Government consumption</td>
<td>21.7</td>
<td>21.1</td>
<td>21.6</td>
<td>21.6</td>
<td>22.5</td>
<td>21.7</td>
<td>22.0</td>
<td>22.6</td>
<td>22.7</td>
<td>21.2</td>
</tr>
<tr>
<td>Non-commercial organiz’s</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Investment</td>
<td>32.5</td>
<td>34.4</td>
<td>32.5</td>
<td>32.1</td>
<td>30.3</td>
<td>31.9</td>
<td>33.0</td>
<td>33.7</td>
<td>33.4</td>
<td>35.0</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>50.7</td>
<td>51.4</td>
<td>56.1</td>
<td>62.7</td>
<td>65.3</td>
<td>73.5</td>
<td>79.6</td>
<td>80.1</td>
<td>82.9</td>
<td>96.3</td>
</tr>
<tr>
<td>Imports of goods and services</td>
<td>55.0</td>
<td>59.2</td>
<td>63.8</td>
<td>70.0</td>
<td>72.6</td>
<td>81.3</td>
<td>89.5</td>
<td>92.5</td>
<td>96.3</td>
<td>109.7</td>
</tr>
</tbody>
</table>

Note: The shares of the production-side and expenditure-side components are calculated with respect to real production-side GDP in 1995 prices.
The GDP index in the Czech Republic did not fluctuate as widely as the GDP indices in Russia and Armenia. At the same time, on average, the Czech national account variables were as volatile as the Russian variables, though less volatile than the Armenian variables. The standard deviation averaged across the indices of the real national account variables equaled 7.8 for the Czech Republic, the same as for Russia (not counting change in inventories). For Armenia, this average equaled 12.1.

Table 3.3.2.2 shows that all of the selected complex regressions – containing principal components, “special” indicators, and other right-hand-side variables as discussed in Chapter 1 – produce very accurate or just accurate current-quarter forecasts for the third and the fourth quarters of 2004. Of the selected regressions, 47% generate very accurate forecasts for both quarters. This is worse than for Russia (55%), but better than for Armenia (23%).

Of the four forecasting approaches, the most accurate current-quarter out-of-sample total GDP forecasts are generated by the direct approach, which is followed by the nominal approach. Both for Russia and Armenia, the most accurate forecasts are obtained through the production-side approach, which is followed by the direct approach. The relative imprecision of the production-side total GDP forecast in the Czech case can probably be explained by the lack of good “special” indicators.

Unlike in the Russian and Armenian models, in the Czech case, the expenditure-side total GDP forecasts are inaccurate for both quarters. This reflects the volatility of exports and imports and the high weights of these variables in total GDP.

Although some forecasts of total GDP are just accurate, the margin of error of the forecast calculated as the average of the forecasts obtained through the four approaches is within the “very accurate” range, for both quarters. At the same time, on balance, the Czech average GDP forecasts are less accurate than the forecasts for Armenia and Russia.
<table>
<thead>
<tr>
<th>Regression</th>
<th>Official index</th>
<th>Forecasted index</th>
<th>Margin of error</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP - direct</td>
<td>1.1</td>
<td>4.03</td>
<td>4.30</td>
</tr>
<tr>
<td>Manufacturing value-added</td>
<td>2.1</td>
<td>5.22</td>
<td>8.57</td>
</tr>
<tr>
<td>Utilities value-added</td>
<td>3.1</td>
<td>7.76</td>
<td>11.18</td>
</tr>
<tr>
<td>Construction value-added</td>
<td>4.1</td>
<td>-6.99</td>
<td>-3.24</td>
</tr>
<tr>
<td>Trade value-added</td>
<td>5.1</td>
<td>5.19</td>
<td>4.00</td>
</tr>
<tr>
<td>Transportation value-added</td>
<td>6.1</td>
<td>3.07</td>
<td>1.76</td>
</tr>
<tr>
<td>Real estate value-added</td>
<td>7.1</td>
<td>0.04</td>
<td>-2.14</td>
</tr>
<tr>
<td>Other sector value-added</td>
<td>8.1</td>
<td>4.68</td>
<td>2.71</td>
</tr>
<tr>
<td>Net taxes on prod's and imp's</td>
<td>9.1</td>
<td>7.54</td>
<td>6.88</td>
</tr>
<tr>
<td>GDP - production side</td>
<td>4.03</td>
<td>4.30</td>
<td>3.86</td>
</tr>
<tr>
<td>Household consumption</td>
<td>10.1</td>
<td>1.99</td>
<td>1.87</td>
</tr>
<tr>
<td>Government consumption</td>
<td>11.1</td>
<td>-3.85</td>
<td>-5.80</td>
</tr>
<tr>
<td>Non-commercial organizations</td>
<td>12.1</td>
<td>11.74</td>
<td>7.07</td>
</tr>
<tr>
<td>Investment</td>
<td>13.1</td>
<td>8.93</td>
<td>4.97</td>
</tr>
<tr>
<td>Exports of goods and services</td>
<td>14.1</td>
<td>22.97</td>
<td>22.15</td>
</tr>
<tr>
<td>Imports of goods and services</td>
<td>15.1</td>
<td>19.86</td>
<td>15.84</td>
</tr>
<tr>
<td>GDP - expenditure side</td>
<td>3.28</td>
<td>4.03</td>
<td>3.99</td>
</tr>
<tr>
<td>Nominal GDP - direct</td>
<td>16.1</td>
<td>8.22</td>
<td>7.75</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>17.1</td>
<td>4.03</td>
<td>3.31</td>
</tr>
<tr>
<td>GDP - nominal approach</td>
<td>4.03</td>
<td>4.30</td>
<td>3.78</td>
</tr>
<tr>
<td>GDP - average</td>
<td>3.84</td>
<td>4.24</td>
<td>3.93</td>
</tr>
</tbody>
</table>

Note: Because of the statistical discrepancy, the growth rates of total GDP calculated as the sum of the production-side components differ from the growth rates of GDP calculated as the sum of the expenditure-side components.

The selected regressions also produce very accurate or just accurate one-quarter-ahead out-of-sample forecasts for the fourth quarter of 2004 when the contemporaneous explanatory variables are themselves projected (see Table 3.3.2.3). In one case, for real estate value-added, this extra step is not needed, since the selected regression does not contain contemporaneous explanatory variables. The number of very accurate forecasts slightly exceeds the number of forecasts that are just accurate.
As in the case of current-quarter forecasts, the most accurate one-quarter-ahead total
GDP forecast is produced by the direct approach, followed by the nominal approach. All
four aggregate GDP forecasts are very accurate.

| Table 3.3.2.3. Czech Republic National Account Growth Rates, Official Figures and
| Next-Quarter Out-of-Sample Forecasts, % |
|-----------------------------------------|----------------|----------------|----------------|
| Regression                              | Official index | Forecasted index | Margin of error |
| GDP - direct                            | 1.1            | 4.30            | 4.25           | 0.05           |
| Manufacturing value-added               | 2.1            | 8.57            | 8.70           | -0.14          |
| Utilities value-added                   | 3.1            | 11.18           | 11.39          | -0.21          |
| Construction value-added                | 4.1            | -3.24           | -1.90          | -1.34          |
| Trade value-added                       | 5.1            | 4.00            | 2.90           | 1.11           |
| Transportation value-added              | 6.1            | 1.76            | 2.33           | -0.57          |
| Real estate value-added                 | 7.1            | -2.14           | -0.68          | -1.46          |
| Other sector value-added                | 8.1            | 2.71            | 4.10           | -1.40          |
| Net taxes on prod's and imp's           | 9.1            | 6.88            | 6.50           | 0.38           |
| GDP - production side                   | 4.30           | 4.67            | -0.37          |
| Household consumption                   | 10.1           | 1.87            | 2.58           | -0.70          |
| Government consumption                  | 11.1           | -5.80           | -4.46          | -1.34          |
| Non-commercial organizations            | 12.1           | 7.07            | 7.52           | -0.46          |
| Investment                              | 13.1           | 4.97            | 4.52           | 0.45           |
| Exports of goods and services           | 14.1           | 22.15           | 21.63          | 0.52           |
| Imports of goods and services           | 15.1           | 15.84           | 16.25          | -0.42          |
| GDP - expenditure side                  | 4.03           | 3.71            | 0.32           |
| Nominal GDP - direct                    | 16.1           | 7.75            | 8.06           | -0.31          |
| GDP deflator                            | 17.1           | 3.31            | 3.43           | -0.12          |
| GDP - nominal approach                  | 4.30           | 4.48            | -0.18          |
| GDP - average                           | 4.24           | 4.28            | -0.04          |

The one-quarter-ahead forecasts generated by individual national account regressions in
the Czech model are, on average, more accurate than the Russian forecasts (produced
with the use of the two-step method), but less accurate than the Armenian forecasts.
Nevertheless, the forecast obtained through the averaging of the four total GDP estimates
is the most accurate in the Czech case, as individual regression forecast errors cancel each other out.

The official national account data are located within the plus/minus one standard deviation confidence interval estimated on the basis of out-of-sample forecasts generated by all of the selected complex regressions. If a national account variable has a "special" indicator, the forecast margin of error is less than the discrepancy between the official index of the national account variable and the official index of its "special" indicator for both the third and the fourth quarters of 2004, with one exception. The margin of error of the investment index forecast for the fourth quarter of 2004 is slightly higher than the difference between the official investment index and the official index of construction, the “special” indicator for investment. However, on balance, for the two quarters, the margin of error of the forecast produced by the selected regression is less than the discrepancy between the official indices. The confidence interval criterion is not discussed in the text below. Neither is the "special" indicator criterion, with the exception of the investment case.

Most of the selected complex regressions generate more accurate current-quarter out-of-sample forecasts for both quarters than single-variable regressions. However, for almost half of the national account variables, at least one single-variable regression was found that generates a more accurate current-quarter out-of-sample forecast than the complex regression for one quarter of the two. This is more than in the Russian and Armenian models. At the same time, on balance, for the two quarters, the single-variable regression forecasts are less accurate than the complex regression forecasts. When a single-variable regression produces a more accurate forecast than the selected complex regression, the adjusted R-squared for the single-variable regression is always lower than for the complex regression. In the text below, unless otherwise indicated, it should be assumed that the complex regression forecasts are more accurate than the simple regression forecasts.
Special attention is paid to the usefulness of crisis dummy variables, especially in the improvement of out-of-sample forecast accuracy. The comparison of out-of-sample forecasts shows that the introduction of crisis dummy variables improves forecasts only in a few complex and single-variable regressions. In the Russian model, crisis dummies play a much more important role. This is not surprising since the Czech crisis was much less severe than the Russian crisis.

As in the description of the Russian and Armenian models, residual tests are mentioned below only when there appears to be a problem.

Regression specifications and outputs and forecast summary tables for the Czech model are provided in Appendix C.

**GDP.** The selection of monthly indicators – overall 16 – used for the extraction of principal components for the Czech GDP regression followed the principles described in Section 1.1 for Russian GDP regression principal components. 56 Regression 1.1 includes three principal components jointly explaining 49.1% of the variance in the original indicators. Two components are entered with a lag. The adjusted R-squared of 0.957 shows that this regression provides an excellent fit of the data.

\[
\text{GDP} = C(1) + C(2) \times \text{PC1} + C(3) \times \text{PC6(-2)} + C(4) \times \text{PC3(-3)} + [\text{AR(1)=C(5)}, \text{AR(2)=C(6)}, \text{MA(4)=C(7)}] \tag{1.1}
\]

After the reduction of the sample by two quarters and the re-estimation of Regression 1.1 based on the reduced sample, the values of GDP were forecasted using the official values of monthly indicators for the out-of-sample period – the third and the fourth quarters of 2004. The forecast margins of error, equaling 0.08 percentage point for the third quarter and 0.12 percentage point for the fourth quarter, are within the “very accurate” range.

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56 All variables in the Czech model are year-over-year indices, with the exception of confidence indices and the interest rate.
The coefficients for crisis dummy variables introduced in Regression 1.1 are statistically insignificant.

Of the signs of the partial derivatives of GDP with respect to the monthly indicators, the negative signs of the derivatives with respect to the ratio of merchandise exports to imports, the koruna/euro exchange rate, and the koruna/dollar exchange rate seem counterintuitive. The negative signs of the GDP partial derivatives with respect to the export-to-import ratio and the exchange rate were also encountered in the Russian case (see Section 3.1 for a possible explanation). In the Armenian model, the sign of the partial derivative with respect to imports was positive, and the magnitude of this derivative exceeded the magnitude of the derivative with respect to exports. The correlations between the Czech GDP index, on the one hand, and the indices of the export-to-import ratio and the two exchange rates, on the other hand, are also negative.

The out-of-sample current-quarter GDP forecasts produced by single-variable regressions are also quite precise. None of the forecasts is inaccurate or even border-line accurate. Four of the six estimated regressions – on manufacturing production (1.2), transportation sales (1.3), the unemployment rate (1.4), and M2 (1.7) – generate very accurate forecasts for both quarters. The forecasts produced by the other two regressions – on average industrial wage (1.5) and the ratio of consumer prices to industrial producer prices (1.6) – are just accurate. The fourth quarter Regression 1.2 forecast is slightly more accurate than the forecast obtained through Regression 1.1. However, on balance, for the two quarters, Regression 1.1 produces more accurate forecasts. The adjusted R-squared is higher for Regression 1.1 than for Regression 1.2.

Regression 1.1 also produces a very accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal component is itself projected for the fourth quarter of 2004. The margin of GDP forecast error is 0.05 percentage point.

*Manufacturing Value-Added.* Manufacturing is currently the largest sector in the Czech economy. It was also the fastest growing sector during the period under consideration.
Despite a setback that followed the 1997 crisis, the share of manufacturing in GDP rose from 21.6% in 1995 to 28.5% in 2004. The correlation between the GDP index and the manufacturing value-added index, 0.48, was higher than the correlation coefficient between the GDP index and any other value-added index with the exception of the index of utilities value-added.

*Figure 3.3.2.1. Czech Republic: Manufacturing Value-Added and Manufacturing Production, Quarterly Year-Over-Year Indices*

The logical candidate for the role of “special” indicator for manufacturing value-added is manufacturing production. The problem is that the two variables were negatively correlated during the period under consideration: the correlation coefficient between the respective indices was -0.28. The fact that the dynamics of the manufacturing value-added index were quite different from the dynamics of the manufacturing production index during almost the entire period is evident from Figure 3.3.2.1. The average absolute value of the difference between the two indices was a high 9.0 percentage points, and for many quarters this discrepancy was in double-digits. Therefore, no "special" indicator was used for manufacturing value-added.
Regression 2.1 on principal components generates a very accurate current-quarter out-of-sample forecast of manufacturing value-added (MNFCVA) for both the third and the fourth quarters of 2004. The higher margin of error is 0.34 percentage point. Regression 2.1 includes a crisis dummy variable. If this variable is dropped, forecast accuracy deteriorates for both quarters. While the third-quarter forecast remains very accurate, the fourth-quarter projection becomes just accurate.

\[
\text{MNFCVA} = C(1) + C(2)\text{PC1(-4)} + C(3)\text{DUMMYPC1(-4)} + C(4)\text{PC5} + \[\text{AR(1)}=C(5),\text{MA(4)}=C(6)]
\] (2.1)

With one exception, for at least one quarter of the two, a current-quarter out-of-sample forecast of manufacturing value-added generated by a single-variable regression is inaccurate. The exception is Regression 2.4 on construction, which provides accurate forecasts of manufacturing value-added for both quarters. Regression 2.7 on retail trade generates a very accurate forecast for one quarter. Regression 2.3 on the money supply and Regression 2.8 on the koruna/euro exchange rate produce accurate forecasts for one quarter. The forecast obtained from Regression 2.5 on transportation sales for the fourth quarter is border-line accurate. Finally, Regression 2.6 on average industrial wage produces inaccurate forecasts for both quarters.

Regression 2.1 also generates a very accurate one-quarter-ahead out-of-sample forecast with the margin of error of 0.14 percentage point for the fourth quarter of 2004 when the contemporaneous principal component is itself projected.

Utilities Value-Added. This is the smallest of the production-side components examined in this study. Relative to GDP, this sector declined during almost the entire period under consideration. In 2004, the share of this sector in GDP stood at 3.0%, two percentage points less than in 1995. Despite its small size, this sector posted a relatively strong correlation with GDP – the correlation coefficient between the indices of the two variables was 0.53.
The correlation of the index of utilities value-added with the index of utilities production, the candidate for the role of "special" indicator, was 0.59, even stronger. Unfortunately, at the same time, the difference between the utilities value-added and utilities production indices was quite substantial, especially in the third quarter of 2000, when utilities value-added more than doubled compared to a year earlier, while utilities production rose only 14.5%. The average absolute value of the difference between the indices of the two variables was a high 14.5 percentage points. Because of this, utilities production was not used as the "special" indicator for utilities value-added. An intercept dummy variable (DUMMY2) was introduced for the third quarter of 2000.

*Figure 3.3.2.2. Czech Republic: Utilities Value-Added and Utilities Production, Quarterly Year-Over-Year Indices*
Regression 3.1 on principal components generates an accurate current-quarter out-of-sample forecast of utilities value-added (UTVA) for the third quarter of 2004 and a very accurate forecast for the fourth quarter. The higher margin of error is 0.87 percentage point. The coefficients for crisis dummy variables entered into Regression 3.1 are statistically insignificant.

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times UTVA(-4) + C(4) \times PC1 + C(5) \times PC2 + C(6) \times PC4 + C(7) \times PC11(-3) + [MA(7)=C(8)] \] 

(3.1)

Regression 3.3 on manufacturing production and Regression 3.4 on the industrial confidence index generate, respectively, an accurate and a border-line accurate out-of-sample forecast for one quarter of the two quarters. The forecast for the other quarter is inaccurate. The forecasts produced by other single-factor regressions, including Regression 3.2 on utilities production, are inaccurate for both quarters.

Regression 3.1 provides an accurate one-quarter-ahead out-of-sample forecast of utilities value-added when the contemporaneous principal components are themselves projected. The margin of error is 0.21 percentage point.

Construction Value-Added. This is the second smallest of the Czech sectors considered in this study. Despite the rapid rise in investment, the construction value-added share in GDP plunged from 8.6% in 1995 to 4.1% in 2005. This sector’s dynamics appears completely different from the dynamics of the economy as a whole. The correlation between the GDP and construction value-added indices was –0.01. The correlation coefficient between the construction value-added index and the construction activity index was 0.29, relatively low. The average absolute value of the difference between the indices of the two variables was a high 11.7 percentage points. Construction activity appears to be much more closely related to investment (see below) than to construction value-added.
Nevertheless, construction has proven itself useful as the “special” indicator for construction value-added. Regression 4.1 on construction (CONSTR) and principal components produces very accurate current-quarter out-of-sample forecasts of construction value-added (CONSTRVA) for both quarters. The higher margin of error is 0.41 percentage point. The coefficients of some crisis dummy variables entered into Regression 4.1 are statistically insignificant. In other cases, the introduction of crisis dummies results in the presence of serial correlation in the residuals.

\[
\text{CONSTRVA} = C(1) + C(2)\times\text{CONSTR} + C(3)\times\text{CONSTR}(-1) + C(4)\times\text{PC4} + C(5)\times\text{PC11} + C(6)\times\text{PC2}(-1) + [\text{AR}(4)=C(7),\text{MA}(8)=C(8)]
\]  

(4.1)

Figure 3.3.2.3. Czech Republic: Construction Value-Added and Construction, Quarterly Year-Over-Year Indices

The forecasts generated by single-variable regressions are inaccurate for at least one quarter of the two. Regression 4.2 on construction and Regression 4.4 on M2 produce
accurate forecasts for one quarter. Regression 4.6 on transportation sales provides a border-line forecast for one quarter. The forecasts obtained from the rest of the single-variable regressions are inaccurate for both quarters.

Regression 3.1 generates an accurate one-quarter-ahead out-of-sample forecast with the margin of error of 1.34 percentage points when the contemporaneous independent variables are themselves projected.

Trade Value-Added. This sector includes retail and wholesales trade. Relative to GDP it grew steadily through 2001, peaking at 15.3%, a 4.7-percentage point increase compared to 1995. By 2004, it declined to 14.2%. A peculiar feature of Czech trade value-added is that it was negatively correlated with GDP, household consumption, and retail trade. The correlation coefficients between the trade value-added index, on the one hand, and the indices of these three variables, on the other hand, were, respectively, -0.27, -0.22, and -0.29. Trade value-added posted double-digit growth in 1997 and 1998, when the economy contracted. Due to the negative correlation between trade-value-added and retail trade, the latter was not used as the “special” indicator for the former. In contrast, retail trade was strongly positively correlated with both GDP and household consumption, and it was selected as the “special” indicator for household consumption (see below).

Regression 5.1 of trade value-added (TRADEVA) on principal components provides accurate current-quarter out-of-sample forecasts with the higher margin of error of 1.12 percentage points. The introduction of a crisis dummy variable in Regression 5.1 may lead to a slightly higher adjusted R-squared, but does not improve the out-of-sample forecasts. For example, the forecasts obtained from Regression 5.2 are inaccurate for both quarters.

\[
\text{TRADEVA} = C(1) + C(2)\times PC2 + C(3)\times PC4 + C(4)\times PC1(-1) + C(5)\times PC9(-1) + C(6)\times PC2(-2) + C(7)\times PC1(-4) + [\text{MA}(4)=C(8)] \\
\text{(5.1)}
\]
The out-of-sample forecasts produced by the estimated single-variable regressions are inaccurate for at least one-quarter of the two. The third-quarter forecast generated by Regression 5.7 on the trade confidence index is very accurate. At the same time, the margin of error for the fourth-quarter forecast produced by this regression is higher than the margin of error of forecasts obtained from any other regression for this quarter. Thus, on balance, Regression 5.1 provides much more precise out-of-sample forecasts than Regression 5.7. Also, the adjusted R-squared is much higher for Regression 5.1 than for Regression 5.7. Another problem with Regression 5.7 is that the coefficient for the trade confidence index is negative.
Regression 5.1 produces an accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal components are themselves projected. The margin of error is 1.11 percentage points. Regression 5.9, which is applied to project PC2, includes a crisis dummy variable.

*Transportation and Communication Value-Added.* This is a small component. Moreover, its share in GDP declined during the period under consideration. In 2004, it stood at 8.4%, down from 9.7% in 1995. The sector’s dynamics were highly erratic, showing relatively little correlation with dynamics observed in the economy as a whole and in many other sectors. The correlation between the transportation value-added and GDP indices was a mere 0.04. Also, surprisingly, this sector’s value-added was negatively correlated with construction value-added and trade value-added – the correlation coefficients between the transportation value-added and the two respective indices were -0.39 and -0.46. Similarly puzzling was the lack of correlation with the transportation sales index – the correlation coefficient was 0.02. Therefore, no “special” indicator was used for this variable.

Regression 6.1 on principal components generates a very accurate current-quarter out-of-sample forecast of transportation value-added (TRANSPVA) for the third quarter of 2004 and an accurate forecast for the fourth quarter. The higher margin of error is 0.76 percentage point. The coefficients for crisis dummy variables introduced in Regression 6.1 are statistically insignificant.

\[
\text{TRANSPVA} = C(1) + C(2)\times\text{TRANSPVA}(-4) + C(3)\times\text{PC8} + C(4)\times\text{PC2}(-1) + C(5)\times\text{PC3}(-1) + C(6)\times\text{PC4}(-1) + \left[\text{MA}(8)=C(7)\right]
\]  

(6.1)

With one exception, the estimated one-variable regressions produce inaccurate out-of-sample forecasts of transportation value-added for at least one quarter of the two. This exception is Regression 6.5 on the ratio of consumer prices to transportation prices, which generates accurate forecasts for both quarters. Regression 6.2 on real utilities
production produces a very accurate forecast for one quarter. Regression 6.3 on transportation sales and Regression 6.5 on the ratio of government budget expenditures to revenues provide accurate forecasts for one quarter. The forecasts obtained from the rest of the estimated single-variable regressions are inaccurate for both quarters.

*Figure 3.3.2.5. Czech Republic: Transportation Value-Added and Transportation Sales, Quarterly Year-Over-Year Indices*

Regression 6.1 produces an accurate one-quarter-ahead out-of-sample forecast when PC8, the only contemporaneous principal component, is itself projected. The margin of error is 0.57 percentage point. Regression 6.8 applied to project PC8 includes a crisis dummy variable.

*Real Estate, Renting, and Business Activities Value-Added.* This is a medium-sized sector whose share in GDP changed very little during the period under consideration. In 2004, it stood at 11.8%, down 0.1 percentage point from 1995. Despite the stability of
this variable relative to GDP, the correlation between the index of real estate value-added and the GDP index was a mere 0.06. This, combined with the fact that real estate value-added does not have a “special” indicator and that it was quite volatile during the period under consideration, complicates forecasting.

Figure 3.3.2.6. Czech Republic: Real Estate Value-Added, Quarterly Year-Over-Year Indices

Nevertheless, Regression 7.1 on principal components provides an accurate current-quarter out-of-sample forecast of real estate value-added (REALESTVA) for the third quarter of 2004 and a very accurate forecast for the fourth quarter. The higher margin of error is 0.8 percentage point. The coefficients of crisis dummy variables entered into this regression are statistically insignificant. Regression 7.1 does not include any contemporaneous principal components either, since their introduction makes out-of-sample forecasts less accurate. This is probably related to the weak contemporaneous correlation between real estate value-added and most of the monthly indicators.
\[
\text{REALESTVA} = C(1) + C(2)\text{REALESTVA}(-1) + C(3)\text{REALESTVA}(-3) + \\
C(4)\text{PC6}(-1) + C(5)\text{PC5}(-3) + [\text{AR}(1)=C(6),\text{AR}(2)=C(7),\text{MA}(5)=C(8)]
\]  
(7.1)

With two exceptions, for at least one quarter of the two, a current-quarter out-of-sample forecast generated by a single-variable regression is inaccurate. Regression 7.3 on M2 and Regression 7.2 on utilities production generate, respectively, a very accurate and a just accurate forecast for one quarter, while for the other quarter, the forecast is borderline accurate. Regressions 7.4 on the real interest rate and Regression 7.6 on the koruna/euro exchange rate provide accurate forecasts for the third quarter. In fact, these forecasts are more accurate than the forecasts generated by Regression 7.1. However, on balance, for the two quarters, the Regression 7.1 forecasts are more accurate than the forecasts obtained from Regression 7.4 and Regression 7.6. Also, the adjusted R-squared is substantially higher for Regression 7.1 than for these two single-variable regressions. Regression 7.7 on the unemployment rate generates a borderline accurate forecast for one-quarter. Finally, the forecasts obtained from Regression 7.5 on the ratio of government budget expenditures to revenues are inaccurate for both quarters.

Since Regression 7.1 does not include contemporaneous independent variables, projections of these variables are not needed for next-quarter forecasting.

*Other Sector Value-Added.* In 1995, this was the largest of the production-side GDP components examined in the study; its share of GDP equaled 23.1%. During the period under consideration, this share declined and industrial value-added became the largest production-side component. In 2004, other sector value-added accounted for 18.6% of GDP. The correlation between the other sector value-added and GDP indices was 0.42, neither very high nor low. There is no “special” indicator for this variable.

Regression 8.1 on principal components generates an accurate current-quarter out-of-sample forecast of other sector value-added (OTHVA) for the third quarter of 2004 and a very accurate forecast for the fourth quarter. The higher margin of error is 0.83. The
coefficients of crisis dummy variables entered into this regression are statistically insignificant.

\[
\text{OTHVA} = C(1) + C(2)\text{OTHVA}(-1) + C(3)\text{PC6} + C(4)\text{PC3}(-1) + C(5)\text{PC6}(-1) + C(6)\text{PC3}(-4) + C(7)\text{PC5}(-4) + C(8)\text{PC6}(-4) + [\text{MA}(6)=C(9)]
\] (8.1)

\textit{Figure 3.3.2.7. Czech Republic: Other Sector Value-Added, Quarterly Year-Over-Year Indices}

None of the estimated single-variable regressions provides a very accurate out-of-sample forecast of other sector value-added for either of the quarters. Regression 8.7 on the interest rate generates an accurate forecast for one quarter and a border-line accurate forecast for the other quarter. Regression 8.3 on average industrial wage and Regression 8.6 on the koruna/euro exchange rate also produce accurate forecasts for one quarter, but the forecasts for the other quarter are inaccurate. Regression 8.2 on retail trade provides border-line accurate forecasts for both quarters. The forecasts obtained from the other single-variable regressions are border-line accurate for one quarter, but inaccurate for the other quarter.
Regression 8.1 produces an accurate one-quarter-ahead out-of-sample forecast when the contemporaneous principal component is itself projected. The margin of error is 1.40 percentage points.

Net Taxes on Products and Imports. The share of this GDP component stood at 11.1% in 1995. After declining in the middle of the period under consideration, it rebounded to 11.4% in 2004. The correlation of the net taxes index with the GDP index was 0.45, neither very high nor low. The monthly government budget indicators, as well as their combinations, do not seem to match this category of taxes from national accounts. Therefore, no “special” indicator was selected for this variable.

Regression 9.1 on principal components generates very accurate current-quarter out-of-sample forecasts of net taxes on products and imports (TAX) for both the third and the second quarters of 2004. The higher margin of error is 0.02 percentage point. The
coefficients of crisis dummy variables entered into Regression 9.1 are statistically insignificant.

\[
\text{TAX} = \text{C}(1) + \text{C}(2) \times \text{PC1} + \text{C}(3) \times \text{PC8} + [\text{AR}(1) = \text{C}(4), \text{MA}(4) = \text{C}(5)] \quad (9.1)
\]

None of the estimated single-variable regressions provides very accurate out-of-sample forecasts for both quarters. The forecasts obtained from Regression 9.4 on average industrial wage and Regression 9.6 on transportation sales are very accurate for one quarter and just accurate for the other quarter. Regression 9.7 on the ratio of government budget expenditures to revenues also generates a very accurate forecast for one quarter, but for the other quarter, the forecast is inaccurate. The forecasts provided by Regression 9.2 on retail trade and Regression 9.5 on industrial production are accurate for at least one quarter of the two. The forecast for the other quarter produced by the former regression is also accurate, while the latter produces an inaccurate forecast. Regression 9.3 on M2 provides a border-line accurate forecast for one quarter, while for the other quarter the forecast is inaccurate.

Regression 9.1 generates a very accurate forecast of net taxes with the margin of error of 0.38 when the principal components, which are both contemporaneous, are themselves projected. A crisis dummy variable is included in Regression 9.8 applied to project PC8.

*Household Consumption.* Relative to GDP, this component grew more or less steadily during the period under consideration. In 2004, the household consumption-to-GDP ratio equaled 53.0%, up 3.6 percentage points from 1995. The correlation between the household consumption and GDP indices was 0.68, the second highest correlation between the index of a GDP component and the GDP index.

Unlike the Russian and Armenian statistical offices, the CSO does not release monthly data on consumer spending. The “special” indicator for household consumption in the Czech case is retail trade. The correlation between the indices of these two variables was a high 0.82. The average absolute value of the difference between the two indices was
1.99 percentage points, relatively low. This discrepancy was in single-digits during the entire period under consideration and had a tendency to narrow toward the end of the period when household consumption and retail trade became less volatile than in the 1990s.

Figure 3.3.2.9. Czech Republic: Household Consumption and Retail Trade, Quarterly Year-Over-Year Indices

Regression 10.1, which includes retail trade (RTRADE) and principal components, produces a very accurate current-quarter out-of-sample forecast of household consumption (HOUS) for the third quarter of 2004 and an accurate forecast for the fourth quarter. The higher margin of error is 0.80 percentage point. This regression includes a crisis dummy variable. If it is omitted, the ARCH test indicates the presence of conditional heteroscedasticity in the residuals.
HOUS = C(1) + C(2)*RTRADE + C(3)*PC1 + C(4)*PC2 + C(5)*PC5 +
C(6)*PC2(-1) + C(7)*DUMMYPC2(-1) + [MA(5)=C(8)]

Regression 10.2, which includes only retail trade, but no principal components, also
generates a very accurate forecast for the third quarter and an accurate forecast for the
fourth quarter, but the margin of error is higher than for the forecasts obtained through
Regression 10.1. Regression 10.1 also has a higher adjusted R-squared than Regression
10.2. Regressions on the real koruna/euro exchange rate (10.5), M2 (10.3), real average
industrial wage (10.4), and the real koruna/dollar exchange rate (10.6) provide an
accurate forecast for one of the two quarters. The forecasts for the other quarter are,
respectively, very accurate, accurate, border-line accurate, and inaccurate.

Regression 10.1 generates an accurate one-quarter-ahead out-of-sample forecast of
household consumption when the contemporaneous independent variables are themselves
projected. The margin of error is 0.70 percentage point. A crisis dummy variable is
included in Regression 10.8, which is applied to project PC2.

*Government Consumption.* Not counting a substantial decline in 2004, the share of this
sector in GDP was relatively stable during the period under consideration. In 2004, it
stood at 21.2%, down 0.6 percentage point from 1995. Despite its stability relative to
GDP, government consumption was not correlated with GDP – the correlation coefficient
between the indices of the two variables was 0.01. No “special” indicator can be
identified for this variable in the Czech Republic. Theoretically, government budget
spending could be applied as a “special” indicator. The problem is that available data do
not allow for estimating *real* budget spending in the Czech case.

Regression 11.1 on principal components generates very accurate current-quarter out-of-
sample forecasts of government consumption (GOV) for both the third and the fourth
quarter of 2004 with the higher margin of error equaling 0.39 percentage point. This
regression includes a crisis dummy variable. If this variable is omitted (see Regression
11.2), the forecast for the fourth quarter improves, but the third-quarter forecast becomes
just accurate. On balance, for the two quarters, Regression 11.1 provides more accurate forecasts than Regression 11.2. The former regression also has a higher adjusted R-squared than the latter.

\[
\text{GOV} = C(1) + C(2)\cdot\text{GOV}(-2) + C(3)\cdot\text{PC2} + C(4)\cdot\text{PC5} + C(5)\cdot\text{PC6} + C(6)\cdot\text{PC7}(-2) + C(7)\cdot\text{PC1}(-3) + C(8)\cdot\text{DUMMYPC1}(-3) + C(9)\cdot\text{PC4}(-4) + [\text{MA}(4)=C(10)] \\
(11.1)
\]

*Figure 3.3.2.10. Czech Republic: Government Consumption, Quarterly Year-Over-Year Indices*

Of the estimated single-variable regressions, the most precise current-quarter out-of-sample forecasts of government consumption are provided by Regression 11.8 on the ratio of merchandise exports to imports. The third-quarter forecast is, actually, more accurate than the forecast generated by Regression 11.1. However, the fourth quarter forecast is just accurate and on balance the Regression 11.1 forecasts are more accurate than those obtained from Regression 11.8. Regression 11.1 also has a much higher adjusted R-squared than Regression 11.8. The rest of the single-variable regressions
provide inaccurate forecasts for at least one quarter of the two. Regression 11.4 on the ratio of government budget expenditures to revenues and Regression 11.3 on M2 generate, respectively, a very accurate forecast and an accurate forecast for one quarter. The other regressions produce inaccurate forecasts for both quarters.

With the exception of Regression 11.2, the fourth-quarter forecasts produced by all of the estimated regressions are less precise than the third-quarter forecasts. Also, the fourth-quarter forecasts generated by all of the regressions underestimate the decline in government consumption in that quarter.

Regression 11.1 generates an accurate one-quarter-ahead out-of-sample forecast of government consumption when the contemporaneous principal components are themselves projected. The margin of error is 1.34 percentage points.

*Consumption by Non-Commercial Organizations Serving Households.* This is the smallest national account component considered in this study. In 2004, its share in GDP stood at 0.6%, down from 0.7% in 1995. The correlation between the index of non-commercial organization consumption and the GDP index was 0.27, quite weak. Also complicating the forecasting of this variable is the lack of a “special” indicator.

Regression 12.1 on principal components provides accurate current quarter out-of-sample forecasts of consumption by non-commercial organizations (NCO) for both the third and the fourth quarters of 2004. This higher margin of error is 0.91 percentage points. The introduction of a crisis dummy variable in Regression 12.1 results in less accurate out-of-sample forecasts. For example, although the fourth-quarter forecast generated by Regression 12.2 is more accurate than the forecast produced by Regression 12.1, because of the widening of the margin of error of the third-quarter forecast, on balance, for the two quarters, forecast accuracy deteriorates when the crisis dummy is entered. Also, the adjusted R-squared is slightly higher for Regression 12.1 than for Regression 12.2.
The current-quarter out-of-sample forecasts generated by the estimated single-variable regressions are inaccurate for at least one quarter of the two with one exception. Regression 12.6 on M2 provides an accurate forecast for one quarter and a border-line accurate forecast for the other quarter. Two regressions, on retail trade (12.3) and average industrial wage (12.4), provide very accurate forecasts for the fourth quarter. They are more accurate than the fourth-quarter forecasts generated by Regression 12.1. However, on balance, the forecasts obtained from Regression 12.1 are more precise. Also, the adjusted R-squared for Regression 12.1 is much higher than for Regression 12.3 and for Regression 12.4. Regression 12.5 on the ratio of government budget expenditures to revenues generates an accurate forecast for one quarter. The remaining single-variable regressions produce inaccurate forecasts for both quarters.
Regression 12.1 generates a very accurate one-quarter-ahead out-of-sample forecast for the fourth quarter of 2004 when the contemporaneous principal components are themselves projected. The margin of error is 0.46 percentage point.

*Total Investment.* This indicator includes both gross fixed investment and change in inventories. Despite a decline as a result of the crisis, the share of total investment in GDP rose during the period under consideration. In 2004, it stood at 35.0%, up 2.5 percentage points from 1995. This variable was significantly correlated with overall economic activity – the correlation coefficient between the GDP index and the total investment index was 0.69, the greatest correlation between the GDP index and the index of a GDP component considered in this study.

*Figure 3.3.2.12. Czech Republic: Total Investment and Construction, Quarterly Year-Over-Year Indices*
In the Russian and Armenian models, monthly fixed investment was used as the “special” indicator for national account investment. The Czech Republic does not publish such statistics. Another choice for the role of investment “special” indicator can be construction. The coefficient between the total investment index and the construction index was 0.44, not a low number. In the fourth quarter of 2004, the difference between the two indices was only 0.3 percentage point. However, the average absolute value of this difference was a relatively high 6.9 percentage points. Also, as Figure 3.3.2.12 shows, in most quarters of 2003 and 2004, the discrepancy was quite substantial, and there was no tendency toward the convergence of the two indices. Thus, the construction index cannot be used as a direct estimate of the total investment index.

Regression 13.1 of investment (TOTINV) on construction (CONSTR) and principal components produces very accurate current-quarter out-of-sample forecasts for both the third and the fourth quarters of 2004. The higher margin of error is 0.35 percentage point. The fourth-quarter margin of error is slightly greater than the difference between the official investment and construction indices. At the same time, the third-quarter margin of error is substantially less than the discrepancy between the two official indices. The coefficients of crisis dummy variables introduced in Regression 13.1 are statistically insignificant.

\[
\text{TOTINV} = C(1) + C(2)\times\text{TOTINV}(-4) + C(3)\times\text{CONSTR}(-1) + C(4)\times\text{PC1} + C(5)\times\text{PC8} + C(6)\times\text{PC5}(-1) + [\text{AR}(1)=C(7), \text{MA}(6)=C(8)] \quad (13.1)
\]

Construction is included in Regression 13.1 with a one-quarter lag. If contemporaneous construction were included in this regression its coefficient would be statistically insignificant. Regression 13.2, which includes only construction as an independent variable, produces inaccurate investment forecasts.

Of the other single-variable regressions, the best forecasts are generated by Regression 13.3 on M2. They are very accurate for both quarters. Regressions on transportation sales (13.6) and industrial production (13.4) provide forecasts that are, respectively, accurate
and borderline accurate for one quarter. For the other quarter, they are inaccurate.
Regression 13.5 on the real interest rate produces inaccurate forecasts for both quarters.

Regression 13.1 generates a very accurate one-quarter-ahead out-of-sample forecast when
the contemporaneous principal components are themselves projected. The margin of error
is 0.45 percentage point.

Exports of Goods and Services. The period under consideration saw a tremendous
increase in Czech exports. In 1995, they stood at 50.7% of GDP. By 2004, in 1995 prices,
their share soared to 96.3%. In current prices, this rise in the exports-to-GDP ratio was
slower, to 71.3%, though still remarkable. Unlike the index of merchandise trade
measured in euro (see Section 3.3.1), the index of real exports of goods and services
positively correlated with the GDP index, but the correlation coefficient was only 0.19,
quite low. Surprisingly, the real export index was negatively correlated with the
manufacturing value-added and transportation value-added indices. At the same time, it
was strongly correlated with manufacturing production and transportation sales.

The logical choice for the role of "special" indicator for this variable is merchandise
exports. Measuring merchandise exports in euro appears preferable to measuring them in
U.S. dollars. The index of real exports of goods and services was much more strongly
correlated with the index of merchandise exports measured in euro than with the index of
merchandise exports measured in dollars – the respective correlation coefficients were
0.87 and 0.48. The absolute average value of the difference between the index of real
exports of goods and services and the index of merchandise exports measured in euro was
6.35 percentage points. If merchandise exports were measured in dollars, this discrepancy
would be more than two percentage points higher.

Regression 14.1 on merchandise exports measured in euro (EUROEXP) and principal
components generates an accurate current-quarter out-of-sample forecast of real exports
of goods and services (EXPGS) for the third quarter of 2004 and a very accurate forecast
for the fourth quarter. The higher margin of error is 1.12 percentage points. Regression
14.1 contains a crisis dummy variable. If no crisis dummy is included (see Regression 14.2), the margin of error for the fourth-quarter forecast declines, but the margin of error for the third-quarter forecast rises. On balance, Regression 14.1 provides slightly better out-of-sample forecasts than Regression 14.2. Also, the adjusted R-squared is slightly higher for Regression 14.1 than for Regression 14.2.

$$\text{EXPGS} = C(1) + C(2)\cdot\text{EUROEXP} + C(3)\cdot\text{DUMMYPC5(-2)} + C(4)\cdot\text{PC2(-4)} + \left[\text{AR(1)}=C(5),\text{AR(2)}=C(6),\text{MA(4)}=C(7)\right]$$

(14.1)

*Figure 3.3.2.13. Czech Republic: Real Exports of Goods and Services, Merchandise Exports in Euro, and Merchandise Exports in U.S. Dollars, Quarterly Year-Over-Year Indices*

All of the estimated single-variable regressions produce inaccurate out-of-sample forecasts for at least one quarter of the two. If the principal components are dropped from
Regression 14.1 (see Regression 14.3), the forecasts for the third and the fourth quarter become, respectively, inaccurate and border-line accurate.

Regression 14.4 on transportation sales and Regression 14.6 on the koruna/euro exchange rate generate an accurate forecast for one quarter and an inaccurate forecast for the other quarter. In fact, the third-quarter forecast provided by Regression 14.6 is more accurate than the forecast obtained from Regression 14.1 for the same quarter. However, on balance, for the two quarters, the Regression 14.1 forecasts are more accurate than the Regression 14.6 forecasts. Also, the adjusted R-squared for Regression 14.1 is much greater than for Regression 14.6. The rest of the single-variable regressions generate inaccurate forecasts for both quarters.

Regression 14.1 produces an accurate one-quarter-ahead out-of-sample forecast when merchandise exports, the only contemporaneous variable in this regression, are themselves projected. The margin of error is 0.52 percentage point.

*Imports of Goods and Services.* In 1995, imports of goods and services stood at 55.0% of GDP. By 2004, in 1995 prices, this share almost doubled, reaching 109.7%. The growth of imports was not interrupted even by the recession of 1998-1999. In current prices, they also rose impressively, to 71.7%, though much less than in 1995 prices. The correlation between the index of real imports and the GDP index was 0.49, neither very high nor low.

The logical choice for the role of "special" indicator for this variable is merchandise imports. Measuring merchandise imports in euro seems preferable to measuring them in U.S. dollars. The index of real imports of goods and services was much more strongly correlated with the index of merchandise imports measured in euro than with the index of merchandise imports measured in dollars – the respective correlation coefficients were 0.85 and 0.58. The absolute average value of the difference between the index of real imports of goods and services and the index of merchandise imports measured in euro
was 4.97 percentage points. When merchandise imports are measured in dollars, this discrepancy rises to 8.16 percentage points.

*Figure 3.3.2.14. Czech Republic: Real Imports of Goods and Services, Merchandise Imports in Euro, and Merchandise Imports in U.S. Dollars, Quarterly Year-Over-Year Indices*

Regression 15.1 on merchandise imports measured in euro (EUROIMP) and principal components provides a very accurate current-quarter out-of-sample forecast of real imports of goods and services (IMPGS) for the third quarter of 2004. The fourth-quarter forecast is just accurate. The higher margin of error is 0.99 percentage point. An introduction of a crisis dummy variable in Regression 15.1 may raise the adjusted R-squared, but does not improve the out-of-sample forecasts. For example, the margins of error of the forecasts obtained from Regression 15.2 are higher than the margin of error
of the forecasts produced by Regression 15.1. The third-quarter forecast remains very accurate, but the fourth-quarter forecast becomes inaccurate.

\[ \text{IMPGS} = C(1) + C(2)\times\text{EUROIMP} + C(3)\times\text{PC4} + C(4)\times\text{PC1}(-1) + C(5)\times\text{PC1}(-2) + C(6)\times\text{PC5}(-2) + [\text{AR}(1)=C(7), \text{AR}(2)=C(8), \text{MA}(1)=C(9), \text{MA}(2)=C(10)] \]  

(15.1)

The out of-sample forecasts obtained from the estimated single-variable regressions are inaccurate for at least one quarter of the two. Regression 15.7 on the koruna/dollar exchange rate provides a more accurate forecast for the third quarter than Regression 15.1. However, on balance, for the two quarters, Regression 15.1 generates more accurate forecasts. Also, the adjusted R-squared for Regression 15.1 is much higher than for Regression 15.7. The forecasts obtained from Regression 15.4 on transportation sales and from Regression 15.5 on manufacturing production are border-line accurate for one quarter. The other single-variable regressions, including Regression 15.3, which contains merchandise imports, but no principal components, generate inaccurate forecasts for both quarters.

Regression 15.1 produces a very accurate one-quarter out-of-sample forecast when the contemporaneous explanatory variables are themselves projected. The margin of error is 0.52 percentage point.

*GDP deflator.* The dynamics of the GDP deflator were close to the dynamics of consumer prices. The correlation coefficient between the index of the GDP deflator and the consumer price index was 0.93, and the average absolute value of the difference between the two indices was only 1.1 percentage points. Other price indices, including the industrial producer price index and the transportation price index, were far less strongly correlated with the GDP deflator (the respective correlation coefficients equaled 0.48 and 0.54).
Nevertheless, regressions that include consumer prices as the “special” indicator do not produce, on balance, deflator current-quarter out-of-sample forecasts as accurate as those generated by Regression 16.1 on principal components extracted from the set of monthly indicators that include consumer prices. The forecasts obtained through Regression 16.1 are very accurate for both quarters with the higher margin of error equaling 0.10 percentage point. The coefficients of crisis dummies entered into Regression 16.1 are statistically insignificant.

\[
DEFLATOR = C(1) + C(2)*DEFLATOR(-1) + C(3)*PC1 + C(4)*PC2 +
[AR(1)=C(5),MA(4)=C(6)]
\]  

(16.1)

*Figure 3.3.2.15. Czech Republic: GDP Deflator, Consumer Prices, and Industrial Producer Prices, Quarterly Year-Over-Year Indices*
The partial derivatives of the GDP deflator with respect to the monthly indicators are all positive. None of the partial derivative has a sign that may be considered counterintuitive.

None of the estimated single-variable regressions generates an inaccurate current-quarter out-of-sample forecast for either of the two quarters. Regression 16.2 on consumer process produces very accurate forecasts for both quarters. Forecasts obtained from Regression 16.3 on manufacturing producer prices, Regression 16.4 on transportation prices, Regression 16.5 on construction prices, and Regression 16.6 on the business confidence index are very accurate for one quarter and just accurate for the other quarter. Regression 16.7 on nominal M2 produces an accurate forecast for one quarter and a border-line accurate forecast for the other quarter.

Regression 16.1 also generates a very accurate one-quarter-ahead out-of-sample forecast for the fourth quarter when the principal components are themselves projected. The margin of error is 0.12 percentage point. A crisis dummy variable is included in Regression 16.8, which is used to project PC1.

Nominal GDP. The dynamics of nominal GDP were close to the dynamics of the GDP deflator – the correlation coefficient between the two indices was 0.78. This was especially evident during the recession of 1997-1998. At the same time, the correlation between the nominal GDP index and the real GDP index was a mere 0.06.

Regression 17.1 on principal components provides very accurate current-quarter out-of-sample forecasts of nominal GDP (NGDP) for both the third and the fourth quarters of 2004. The higher margin of error is 0.16 percentage point. Regression 17.1 includes a crisis dummy variable. If it is omitted (see Regression 17.2), the margin of error decreases for the third quarter, but rises for the fourth quarter. On balance, Regression 17.1 produces more accurate out-of-sample forecasts than Regression 17.2. Also, the adjusted R-squared is much higher for Regression 17.1 than for Regression 17.2.
Because of the crisis dummy in the selected regression, two sets of the partial derivatives of nominal GDP with respect to the monthly indicators were calculated, one for the pre-crisis period and the other for the post-crisis period. In both cases, all of the partial derivatives are positive. There is no partial derivative in either set whose sign would appear counterintuitive.

Three single-variable regressions, on the nominal koruna/dollar exchange rate (17.5), consumer prices (17.6), and the business confidence index (17.7), as well as a regression that includes only a lagged dependent variable and an MA term (17.3), also generate very accurate forecasts for both quarters. Regression 17.4 on the nominal koruna/euro exchange rate, Regression 17.8 on nominal M2, and Regression 17.9 on nominal merchandise imports provide very accurate forecasts for one quarter and just accurate forecasts for the other quarter. Regression 17.4, Regression 17.6, and Regression 17.7
generate more accurate forecasts than Regression 17.1 for one quarter of the two. However, on balance, for the two quarters, Regression 17.1 produces more accurate forecasts. The adjusted R-squared is higher for Regression 17.1 than for any of the estimated single-variable regression.

Regression 17.1 produces a very accurate one-quarter-ahead out-of-sample forecast for the fourth quarter of 2004 when the principal components are themselves projected. The margin of error is 0.31 percentage point. Regression 17.10, which is used to project PC1, includes a crisis dummy variable.
Conclusion

This study showed that despite the shortness of time-series and significant structural change the economies of three transition countries – Russia, Armenia, and the Czech Republic – have started to demonstrate regularities that can be used in some kinds of econometric forecasting. The developed high-frequency models generate relatively accurate short-term forecasts of quarterly national account variables, overall 53 for three countries, and ultimately real GDP. They can serve as a foundation for real-time short-term forecasting models, which can be used in economic decision-making, including government budget preparation. They can also provide initial conditions for medium-term or long-term structural forecasting models.

The two main methodological features of the models – (1) the forecasting of real GDP directly and through its elements and (2) the method of principal components – allow for the incorporation of a large number of explanatory variables. The selected complex forecasting regressions satisfy a series of absolute and comparative forecast accuracy criteria.

First, they provide a good fit of the data – in other words, their in-sample forecasts are relatively accurate. The adjusted R-squared exceeds 0.8 in the Russian regressions that include contemporaneous independent variables. In the Russian regressions that do not include such variables, the adjusted R-squared is higher than 0.75. In the Czech regressions, with the exception of one regression, it exceeds 0.8. In the Armenian regressions, it is over 0.95.58

Second, the selected complex regressions generate relatively precise current-quarter out-of-sample forecasts after the reduction of the historical sample by two quarters. Many of

58 The variables in the Armenian regressions are seasonally unadjusted levels that follow a strong seasonal pattern. The incorporation of seasonal dummies and variables lagged four quarters into regressions, thus, helps explain a substantial portion of the variation in the dependent variables and raises the adjusted R-squared.
these regressions produce forecasts with a margin of error below one-half percentage point for both quarters – 55% for Russia, 23% for Armenia, and 47% for the Czech Republic. Only two regressions (in the Armenian model) produce a forecast with a margin of error over 1.5 percentage points.

Of the four individual approaches to forecasting real GDP, in the Russian and Armenian cases, the most precise current-quarter out-of-sample forecasts are obtained through the summation of the production-side elements. For the Czech Republic, it is the direct approach that generates the most accurate forecasts.

The production-side GDP forecasts are relatively imprecise in the Czech case because of the lack of good “special” indicators, key variables applied by official statisticians to make preliminary estimates of the respective national account variables. These indicators are particularly important when monthly indicators used in the extraction of principal components are not closely related to the forecasted GDP element, but describe the economic conditions in general. The relatively low precision of the expenditure-side forecasts in all three countries can be partially explained by the high volatility of many of the expenditure-side national account variables, such as exports and inventories. Volatility is also a factor behind problems with the forecasting of some variables on the nominal side in the Russian case.

**The Relative Precision of Current-Quarter Forecasting by Approach**

(from Most Precise to Least Precise)

<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Direct</th>
<th>Average</th>
<th>Expenditure</th>
<th>Nominal</th>
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<tbody>
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<td>Production</td>
<td>Direct</td>
<td>Average</td>
<td>Expenditure</td>
<td>Nominal</td>
</tr>
<tr>
<td>Armenia</td>
<td>Average</td>
<td>Production</td>
<td>Direct</td>
<td>Expenditure</td>
<td>Nominal</td>
</tr>
<tr>
<td>Czech Rep.</td>
<td>Direct</td>
<td>Nominal</td>
<td>Average</td>
<td>Production</td>
<td>Expenditure</td>
</tr>
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</table>

The total GDP forecasts calculated as the averages of the GDP forecasts obtained through the four individual approaches have a margin of error below one-half percentage point for

59 The margin of error is the difference between the official and forecasted indices.
all three countries. In the Armenian model, the average GDP forecasts are, actually, more accurate than the forecasts obtained through any of the four approaches.60

Specifically, the Russian model predicts the disappointing economic growth performance in the second and third quarters of 2004 that occurred despite the rise in the world oil price. The Armenian model predicts the slowdown of economic expansion in the same period of 2004 despite an acceleration of the growth of private transfers and continued strong growth of labor income. The Czech model predicts the relatively strong economic expansion in the second half of 2004 despite sluggish growth in EU-15 and Germany, in particular.

Third, the selected regressions generate relatively precise one-quarter-ahead out-of-sample forecasts when the sample is reduced by one quarter and the contemporaneous explanatory variables are themselves projected. In the Russian model, relatively precise one-quarter-ahead out-of-sample forecasts are also obtained from regressions containing no contemporaneous explanatory variables. The forecast margin of error is below 1.5 percentage points for all of the regressions. The total GDP forecasts calculated as the averages of the GDP forecasts obtained through the four different approaches have a margin of error below one-half percentage point for all three countries. In the Russian and Czech models, the average GDP forecasts are more accurate than the forecasts obtained through any of the four approaches.

Fourth, the official figures are located within the plus/minus one standard error confidence interval calculated for the current-quarter-out-of-sample forecasts obtained from the complex regressions after the reduction of the historical sample by two quarters.

Fifth, when a national account variable has a “special” indicator, the margin of error of the current-quarter out-of-sample forecasts generated by most of the complex regressions is less than the difference between the official index of the national account variable and the official index of the corresponding “special” indicator for both quarters. At the same

60 This is common for the similar high-frequency models built for other countries.
time, it was found that for construction value-added and employees’ compensation in Russia and trade value-added in Armenia, a current-quarter model is not needed because the recent official indices of these variables are almost identical to the official indices of their respective "special" indicators. In two cases, for industrial value-added in Russia and investment in the Czech Republic, this criterion is not satisfied for one of the quarters. However, even in these cases, on balance, for the two quarters, the margin of error of the forecasts produced by the selected complex regressions is less than the discrepancy between the official indices.

Sixth, the margin of error of the current-quarter out-of-sample forecasts provided by the complex regressions is compared with the margin of errors of the forecasts generated by simple single-variable regressions. The variables selected for single-variable regressions always include a “special” indicator, if applicable; the world crude oil spot price in the regressions of Russian real national account variables; and labor income, government transfers, current transfers, and Russian GDP in the regressions of Armenian real national account variables.

Most of the selected complex regressions generate more accurate current-quarter out-of-sample forecasts for both quarters than do single-variable regressions. However, for some national account variables (mostly in the Czech model), at least one single-variable regression is found that generates a more accurate current-quarter out-of-sample forecast than the complex regression for one quarter of the two. At the same time, on balance, for the two quarters, the single-variable regression forecasts are less accurate than the complex regression forecasts. When a single-variable regression produces a more accurate forecast than the selected complex regression, the adjusted R-squared for the single-variable regression is always lower for the simple regression than for the complex regression.

It was also found that in one case, for Armenian transportation value-added, the best current-quarter out-of-sample forecasts are generated by an ARMA equation that does
not include any principal components, "special" indicators, or other independent variables.

In several cases, the sign of a partial derivative of a national account with respect to a monthly indicator appears counterintuitive. For example, the negative sign of the partial derivative of Russian GDP with respect to the ruble/U.S. dollar exchange rate means that the ruble’s real depreciation against the dollar is accompanied by a decline in GDP, which contradicts the generally accepted hypothesis that depreciation helps the Russian economy. The partial derivatives of Czech GDP with respect to the koruna/euro exchange rate and the koruna/dollar exchange rate are also negative. In such cases, to ensure that this is not a problem with the model, the signs of partial derivatives are confirmed through other methods: correlation analysis and/or single-variable regression. One possible explanation of the negative sign of the partial derivative with respect to the exchange rate could be the wealth effect. Since consumers in transition countries often tend to measure their wealth in dollars, depreciation decreases perceived wealth, which results in a drop in spending and GDP. At the same time, single-variable regressions demonstrate that the Russian and Czech economies do benefit from depreciation, only with a lag. Since the positive lagged impact of depreciation is stronger than the negative contemporaneous impact, the total effect is positive, which supports the conventional view.

Special attention was paid to the analysis of the usefulness of dummy variables related to the August 1998 crisis in Russia and the May 1997 crisis in the Czech Republic, primarily to improve out-of-sample forecasts. It was found that the introduction of crisis dummy variables improves forecasts for most of the complex and single-variable regressions in the Russian case, but only for a few regressions in the Czech case. This is apparently related to the fact that the Russian crisis was much more severe and led to more substantial structural change than the Czech crisis. The reduction of the historical sample to the post-crisis period is found useful on a very few occasions in the Russian model. In the Russian model, crisis dummies are found more or less equally important in
the forecasting of variables from all sides of national accounting: production, expenditure, and income.

For the Armenian model, an attempt was made to link it to the Russian model by introducing contemporaneous Russian GDP to the Armenian national account variable regressions and to the regressions applied to project contemporaneous explanatory variables from the national account variable regressions. Although contemporaneous Russian GDP coefficients are statistically significant in many regressions, the introduction of this indicator makes the forecasts of the Armenian national account variables, on balance, less accurate.

In general, this study is not intended to prove or disprove that an individual indicator, such as the world oil price in Russia or private transfers in Armenia, plays the key role in determining economic growth. It shows that forecasting accuracy improves if the model takes into account signals from a large variety of indicators.

The model presented here may be used to improve preliminary estimates of national account variables. Systematic testing of this proposition was not conducted. Nevertheless, the example of Russian GDP shows that the model estimates are closer to the revised data than are the preliminary data. This application is worth exploring in future research.
References


Chan, Chi-shing (2002). High Frequency Macroeconomic Forecasting Model for Hong Kong. APEC Study Center, Hong Kong Institute of Economic and Business Strategy, University of Hong Kong


Inada, Yoshihisa (1997). High-Frequency Model for the Japanese Economy, Konan University


World Bank (2004b). World Development Indicators 2004

Appendix A. Russian Model Regressions and Forecast Summary Tables

Crisis Dummy Variables

Intercept Dummy Variables:

- DUMMY2 = 0 for 1996Q2 – 1998Q3, = 1 otherwise
- DUMMY3 = 1 for 1998Q4, = 0 otherwise
- DUMMY8 = 1 for 1998Q3, = 0 otherwise
- DUMMY9 = 1 for 1999Q3, = 0 otherwise

Slope Dummy Variables: ‘DUMMY’ is added to the name of the variable

1. GDP

Variables

The dependent variable: real GDP, the difference of the logarithms of the year-over-year indices – DLGDP

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real freight transportation (in ton-kilometers)
- Real retail sales
- Real inventories in retail sales
- Car production (in physical units)
- Cement production (in physical units)
- Crude oil production (in physical units)
- Electricity production (in physical units)
- Mineral fertilizer production (in physical units)
- Natural gas production (in physical units)
- Steel production (in physical units)
- Employment
- Real ruble/U.S. dollar exchange rate
- Ratio of merchandise exports to merchandise imports (in U.S. dollars)
- Real M2
- Real average wage
- Ratio of consumer prices to industrial producer prices
- Ratio defense spending to total of consolidated government budget spending
- Brent crude oil spot price (in U.S. dollars)
GDP Regressions

1.1. Regression of real GDP on principal components

\[ DLGDP = C(1) + C(2)\cdot PC1 + C(3)\cdot PC2 + C(4)\cdot PC3 + C(5)\cdot PC4 + [MA(4)=C(6),BACKCAST=1996Q2] \]

Dependent Variable: DLGDP
Method: Least Squares

Sample: 1996Q2 2004Q3
Included observations: 34
Convergence achieved after 16 iterations
Backcast: 1995Q2 1996Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.001321</td>
<td>0.000718</td>
<td>1.838919</td>
<td>0.0766</td>
</tr>
<tr>
<td>PC1</td>
<td>0.015430</td>
<td>0.002247</td>
<td>6.865446</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.024292</td>
<td>0.003506</td>
<td>-6.928096</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC3</td>
<td>0.005923</td>
<td>0.004603</td>
<td>-6.928096</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC4</td>
<td>0.010912</td>
<td>0.006890</td>
<td>1.583616</td>
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</tr>
<tr>
<td>MA(4)</td>
<td>-0.927422</td>
<td>0.044149</td>
<td>-21.00676</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.900467  Mean dependent var 0.002677
Adjusted R-squared 0.882693  S.D. dependent var 0.030105
S.E. of regression 0.010311  Akaike info criterion -6.152455
Sum squared resid 0.002977  Schwarz criterion -5.883098
Log likelihood 110.5917  F-statistic 50.66278
Durbin-Watson stat 2.295483  Prob(F-statistic) 0.000000

Inverted MA Roots .98

Chow Breakpoint Test: 1998Q4

<table>
<thead>
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<th>Test Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
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</tr>
<tr>
<td>Log likelihood ratio</td>
<td>13.88477</td>
</tr>
</tbody>
</table>
### 1.2. Regression of real GDP on principal components (with a crisis dummy variable)

\[ DLGDP = C(1) + C(2) \cdot PC1 + C(3) \cdot DUMMYPC1 + C(4) \cdot PC2 + C(5) \cdot PC3 + C(6) \cdot PC4 + [MA(4)=C(7), BACKCAST=1996:2] \]

Dependent Variable: DLGDP  
Method: Least Squares

Sample: 1996:2 2004:3  
Included observations: 34  
Convergence achieved after 12 iterations  
Backcast: 1995:2 1996:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.000776</td>
<td>0.000780</td>
<td>0.994900</td>
<td>0.3286</td>
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<tr>
<td>PC1</td>
<td>0.013872</td>
<td>0.002415</td>
<td>5.743352</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMYPC1</td>
<td>0.002441</td>
<td>0.001596</td>
<td>1.529018</td>
<td>0.1379</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.024014</td>
<td>0.003405</td>
<td>-7.052172</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC3</td>
<td>0.007591</td>
<td>0.004636</td>
<td>1.637371</td>
<td>0.1132</td>
</tr>
<tr>
<td>PC4</td>
<td>0.012273</td>
<td>0.006824</td>
<td>1.798558</td>
<td>0.0833</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.931927</td>
<td>0.033317</td>
<td>-27.97190</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.908375  
Mean dependent var 0.002677

Adjusted R-squared 0.888014  
S.D. dependent var 0.030105

S.E. of regression 0.033317  
Akaike info criterion -6.176421

Sum squared resid 0.002740  
Schwarz criterion -5.862171

Log likelihood 111.9992  
F-statistic 44.61347

Durbin-Watson stat 2.401213  
Prob(F-statistic) 0.000000

Inverted MA Roots .98 .00+.98i -.00 -.98i -.98
1.3. Regression of real GDP on principal components (with a crisis dummy variable; construction is replaced with fixed investment in the set of monthly indicators)

\[ DLGDP = C(1) + C(2)*PC1 + C(3)*DUMMYPC1 + C(4)*PC2 + C(5)*PC3 + C(6)*PC4 + [MA(4)=C(7),BACKCAST=1996:2] \]

1.4. Regression of real GDP on Brent crude oil spot price

\[ DLGDP = C(1) + C(2)*DLBRENT + C(3)*DLBRENT(-1) + [AR(3)=C(4),AR(4)=C(5),MA(2)=C(6),MA(4)=C(7),BACKCAST=1997:3] \]

1.5. Regression of real GDP on real industrial production

\[ DLGDP = C(1) + C(2)*DLIND + C(3)*DUMMYDLIND + C(4)*DLIND(-1) + [MA(4)=C(5),BACKCAST=1996Q3] \]

1.6. Regression of real GDP on real ruble/U.S. dollar exchange rate

\[ DLGDP = C(1) + C(2)*DLREALEXRATE + C(3)*DLREALEXRATE(-2) + [AR(4)=C(5),MA(4)=C(6),BACKCAST=1997:4] \]

1.7. Regression of real GDP on steel production (in physical units)

\[ DLGDP = C(1) + C(2)*DLSTEEL + C(3)*DLSTEEL(-1) + C(4)*DLSTEEL(-4) + [AR(1)=C(5),AR(3)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1998:2] \]

1.8. Regression of real GDP on merchandise imports (in U.S. dollars)

\[ DLGDP = C(1) + C(2)*DLIMBOP + C(3)*DLIMBOP(-2) + C(4)*DUMMYDLIMP(-2) + [AR(4)=C(5),MA(4)=C(6),BACKCAST=1997:4] \]

1.9. Regression of real GDP on electricity production (in physical units)

\[ DLGDP = C(1) + C(2)*DLELEC + C(3)*DUMMYDLELEC + C(4)*DLELEC(-1) + C(5)*DUMMYDLELEC(-1) + [AR(1)=C(6),AR(2)=C(7),AR(4)=C(8),MA(4)=C(9),BACKCAST=1997:3] \]

1.10. Regression of real GDP on real M2

\[ DLGDP = C(1) + C(2)*DUMMY2 + C(3)*DLREALM2 + C(4)*DLREALM2(-2) + [AR(2)=C(5),AR(4)=C(6),MA(2)=C(7),MA(4)=C(8),BACKCAST=1997Q4] \]

1.11. Regression of real GDP on principal components (no contemporaneous independent variables)

\[ DLGDP = C(1) + C(2)*PC3(-1) + C(3)*PC7(-1) + C(4)*PC10(-1) + C(5)*PC9(-2) + C(6)*PC1(-4) + [AR(1)=C(7),AR(2)=C(8),MA(4)=C(9),BACKCAST=1997:4] \]
1.12. Regression of real GDP on principal components (no contemporaneous independent variables; a crisis dummy variable is included)

\[
DLGDP = C(1) + C(2)\cdot PC3(-1) + C(3)\cdot PC7(-1) + C(4)\cdot PC10(-1) + C(5)\cdot PC9(-2) + C(6)\cdot PC1(-4) + C(7)\cdot DUMMYPC1(-4) + [AR(1)=C(8), AR(2)=C(9), MA(4)=C(10), BACKCAST=1997:4]
\]

1.13. Regression of real GDP on principal components (post-crisis sample)

\[
DLGDP = C(1) + C(2)\cdot PC1 + C(3)\cdot PC2 + C(4)\cdot PC3 + C(5)\cdot PC4 + [MA(4)=C(6), BACKCAST=1998:4]
\]

1.14. ARMA PC1 regression

\[
PC1 = C(1) + C(2)\cdot DUMMY8 + C(3)\cdot DUMMY9 + C(4)\cdot PC1(-1) + C(5)\cdot PC1(-3) + C(6)\cdot DUMMYPC1(-3) + [MA(3)=C(7), BACKCAST=1997:1]
\]

1.15. ARMA PC2 regression (post-crisis sample)

\[
PC2 = C(1) + C(2)\cdot PC2(-1) + C(3)\cdot PC2(-3) + [AR(1)=C(4), MA(4)=C(5), BACKCAST=1999:4]
\]

1.16. ARMA PC3 regression (post-crisis sample)

\[
PC3 = C(1) + C(2)\cdot PC3(-1) + [MA(4)=C(3), BACKCAST=1999:1]
\]

1.17. ARMA PC4 regression (post-crisis sample)

\[
PC4 = C(1) + C(2)\cdot PC4(-1) + [MA(4)=C(3), BACKCAST=1999:1]
\]
Table 1.1. Industry Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.51%</td>
<td>7.11%</td>
<td></td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.1</td>
<td>Full</td>
<td>No</td>
<td>7.81%</td>
<td>7.34%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.2</td>
<td>Full</td>
<td>Yes</td>
<td>7.53%</td>
<td>7.16%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs *</td>
<td>1.3</td>
<td>Full</td>
<td>Yes</td>
<td>7.15%</td>
<td>7.20%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>1.4</td>
<td>Full</td>
<td>No</td>
<td>8.55%</td>
<td>9.34%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>1.5</td>
<td>Full</td>
<td>Yes</td>
<td>7.73%</td>
<td>8.77%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Real ruble/dollar exchange rate</td>
<td>1.6</td>
<td>Full</td>
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<td>7.27%</td>
<td>8.10%</td>
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<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Steel production</td>
<td>1.7</td>
<td>Full</td>
<td>No</td>
<td>6.81%</td>
<td>7.57%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>1.8</td>
<td>Full</td>
<td>Yes</td>
<td>7.58%</td>
<td>8.39%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Electricity production</td>
<td>1.9</td>
<td>Full</td>
<td>Yes</td>
<td>9.60%</td>
<td>10.04%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Real M2</td>
<td>1.10</td>
<td>Full</td>
<td>Yes</td>
<td>5.77%</td>
<td>4.07%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.13</td>
<td>Post-crisis</td>
<td>N/A</td>
<td>8.58%</td>
<td>6.49%</td>
</tr>
</tbody>
</table>

Note: * Real construction is replaced with fixed investment in the set of monthly indicators
Table 1.1. Industry Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.11%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.11</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>7.23%</td>
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<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.12</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>7.35%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.2</td>
<td>Full *</td>
<td>No</td>
<td>Yes</td>
<td>7.42%</td>
</tr>
</tbody>
</table>

Note: * PC2, PC3, and PC4 are forecasted on the basis of the post-crisis sample
Table 1.3. Pre-Crisis Partial Derivatives of GDP with Respect to:

<table>
<thead>
<tr>
<th>Description</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural production</td>
<td>0.0021</td>
</tr>
<tr>
<td>Real construction</td>
<td>0.0097</td>
</tr>
<tr>
<td>Real freight transportation (in ton-kilometers)</td>
<td>0.0128</td>
</tr>
<tr>
<td>Real retail sales</td>
<td>0.0059</td>
</tr>
<tr>
<td>Real inventories in retail sales</td>
<td>0.0035</td>
</tr>
<tr>
<td>Car production (in physical units)</td>
<td>0.0132</td>
</tr>
<tr>
<td>Cement production (in physical units)</td>
<td>0.0048</td>
</tr>
<tr>
<td>Crude oil production (in physical units)</td>
<td>0.0039</td>
</tr>
<tr>
<td>Electricity production (in physical units)</td>
<td>0.0147</td>
</tr>
<tr>
<td>Mineral fertilizer production (in physical units)</td>
<td>0.0038</td>
</tr>
<tr>
<td>Natural gas production (in physical units)</td>
<td>0.0082</td>
</tr>
<tr>
<td>Steel production (in physical units)</td>
<td>0.0005</td>
</tr>
<tr>
<td>Employment</td>
<td>0.0040</td>
</tr>
<tr>
<td>Real ruble/U.S. dollar exchange rate</td>
<td>-0.0022</td>
</tr>
<tr>
<td>Ratio of merchandise exports to merchandise imports (in U.S. dollars)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Real M2</td>
<td>0.0008</td>
</tr>
<tr>
<td>Real average wage</td>
<td>0.0029</td>
</tr>
<tr>
<td>Ratio of consumer prices to industrial producer prices</td>
<td>-0.0024</td>
</tr>
<tr>
<td>Ratio defense spending to total of consolidated government budget spending</td>
<td>0.0079</td>
</tr>
<tr>
<td>Brent crude oil spot price (in U.S. dollars)</td>
<td>0.0076</td>
</tr>
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</table>
Table 1.4. Post-Crisis Partial Derivatives of GDP with Respect to:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural production</td>
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</tr>
<tr>
<td>Real construction</td>
<td>0.0103</td>
</tr>
<tr>
<td>Real freight transportation (in ton-kilometers)</td>
<td>0.0132</td>
</tr>
<tr>
<td>Real retail sales</td>
<td>0.0064</td>
</tr>
<tr>
<td>Real inventories in retail sales</td>
<td>0.0044</td>
</tr>
<tr>
<td>Car production (in physical units)</td>
<td>0.0135</td>
</tr>
<tr>
<td>Cement production (in physical units)</td>
<td>0.0052</td>
</tr>
<tr>
<td>Crude oil production (in physical units)</td>
<td>0.0039</td>
</tr>
<tr>
<td>Electricity production (in physical units)</td>
<td>0.0149</td>
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<tr>
<td>Mineral fertilizer production (in physical units)</td>
<td>0.0038</td>
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<tr>
<td>Natural gas production (in physical units)</td>
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<tr>
<td>Steel production (in physical units)</td>
<td>0.0008</td>
</tr>
<tr>
<td>Employment</td>
<td>0.0040</td>
</tr>
<tr>
<td>Real ruble/U.S. dollar exchange rate</td>
<td>-0.0032</td>
</tr>
<tr>
<td>Ratio of merchandise exports to imports (in U.S. dollars)</td>
<td>-0.0006</td>
</tr>
<tr>
<td>Real M2</td>
<td>0.0017</td>
</tr>
<tr>
<td>Real average wage</td>
<td>0.0038</td>
</tr>
<tr>
<td>Ratio of consumer prices to producer prices</td>
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</tr>
<tr>
<td>Ratio defense spending to total of consolidated government budget spending</td>
<td>0.0079</td>
</tr>
<tr>
<td>Brent crude oil spot price (in U.S. dollars)</td>
<td>0.0076</td>
</tr>
</tbody>
</table>
2. Industry

Variables

The dependent variable: real industrial value-added, the difference of the logarithms of the year-over-year indices – DLINDVA

Special indicator: real industrial production, the difference of the logarithms of the year-over-year indices – DLIND

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real retail sales
- Electricity production (in physical units)
- Bread and bread product production (in physical units)
- Car production (in physical units)
- Coal production (in physical units)
- Crude oil production (in physical units)
- Mineral fertilizer production (in physical units)
- Fiber production (in physical units)
- Natural gas production (in physical units)
- Steel production (in physical units)
- Truck production (in physical units)
- Wood production (in physical units)
- Employment
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real ruble/U.S. dollar exchange rate
- Real M2
- Real average wages
- Ratio of freight transportation prices to industrial producer prices
- Ratio of consumer prices to industrial producer prices
- Brent crude oil spot price (in U.S. dollars)
Real Industrial Value-Added Regressions

2.1. Regression of real industrial value-added on real industrial production and a principal component

\[ DLINDVA = C(1) + C(2) * DLIND + C(3) * PC2 + \]
\[ AR(1) = C(4), AR(2) = C(5), AR(4) = C(6), MA(4) = C(7), BACKCAST = 1997:2 \]

Dependent Variable: DLINDVA
Method: Least Squares
Sample(adjusted): 1997:2 2004:3
Included observations: 30 after adjusting endpoints
Convergence achieved after 35 iterations
Backcast: 1996:2 1997:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-6.69E-06</td>
<td>0.000542</td>
<td>-0.012359</td>
<td>0.9902</td>
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<tr>
<td>DLIND</td>
<td>0.872463</td>
<td>0.009174</td>
<td>95.09664</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>0.008978</td>
<td>0.0011181</td>
<td>7.602352</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.614753</td>
<td>0.173514</td>
<td>-3.542965</td>
<td>0.0017</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.492025</td>
<td>0.129711</td>
<td>-3.793253</td>
<td>0.0009</td>
</tr>
<tr>
<td>AR(4)</td>
<td>-0.119420</td>
<td>0.111923</td>
<td>-1.066981</td>
<td>0.2971</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.989988</td>
<td>0.048526</td>
<td>20.40134</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.995650
Adjusted R-squared 0.994516
S.E. of regression 0.003429
Akaike info criterion -8.312270
Schwarz criterion -7.985324
Log likelihood 131.6841
F-statistic 877.4825
Durbin-Watson stat 1.733462
Prob(F-statistic) 0.000000

Inverted AR Roots .16+.42i .16 -.42i -.47+.61i -.47 -.61i
Inverted MA Roots .71+.71i .71+.71i -.71 -.71i -.71 -.71i
2.2. Regression of real industrial value-added on real industrial production

\[ DLINDVA = C(1) + C(2) \times DLIND + \]

2.3. Regression of real industrial value-added on real industrial production and a principal component (a crisis dummy variable is included)

\[ DLINDVA = C(1) + C(2) \times DUMMY2 + C(3) \times DLIND + C(4) \times PC2 + \]
\[ [AR(1)=C(5),AR(2)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1997Q2] \]

2.4. Regression of real industrial value-added on Brent crude oil spot price

\[ DLINDVA = C(1) + C(2) \times DLINDVA(-1) + C(3) \times DLINDVA(-3) + C(4) \times DLBRENT + C(5) \times DLBRENT(-3) + [AR(2)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1998Q1] \]

2.5. Regression of real industrial value-added on the ruble/dollar real exchange rate

\[ DLINDVA = C(1) + C(2) \times DLREAL EXRATE + C(3) \times DLREAL EXRATE(-1) + [AR(4)=C(4),MA(4)=C(5),BACKCAST=1997Q3] \]

2.6. Regression of real industrial value-added on freight transportation in tons-kilometers

\[ DLINDVA = C(1) + C(2) \times DLTRANSPORT + C(3) \times DLTRANSPORT(-1) + C(4) \times DLTRANSPORT(-2) + C(5) \times DLTRANSPORT(-3) + C(6) \times DLTRANSPORT(-4) + [AR(1)=C(7),AR(4)=C(8),MA(4)=C(9),BACKCAST=1998Q2] \]

2.7. Regression of real industrial value-added on real M2

\[ DLINDVA = C(1) + C(2) \times DLREALM2 + C(3) \times DUMMYDLREALM2 + C(4) \times DLREALM2(-2) + [AR(1)=C(5),AR(3)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1997Q4] \]

2.8. Regression of real industrial value-added on real industrial production and principal components (no contemporaneous independent variables)

\[ DLINDVA = C(1) + C(2) \times DLIND(-4) + C(3) \times DUMMYDLIND(-4) + C(4) \times PC6(-1) + C(5) \times PC12(-1) + C(6) \times PC1(-4) + [MA(4)=C(7),BACKCAST=1997:2] \]

2.9. Regression of real industrial value-added on real industrial production (no contemporaneous independent variables)

\[ DLINDVA = C(1) + C(2) \times DUMMY2 + C(3) \times DLIND(-4) + C(4) \times DUMMYDLIND(-4) + [MA(4)=C(5),BACKCAST=1997:2] \]
2.10. Regression of real industrial value-added on real industrial production and principal components (post-crisis sample)

\[
DLINDVA = C(1) + C(2)\times DLIND + C(3)\times PC2 + [MA(4)=C(4), BACKCAST=1998Q4]
\]

2.11. ARMA real industrial production regression

\[
DLIND = C(1) + C(2)\times DUMMY2 + C(3)\times DLIND(-4) + C(4)\times DUMMYDLIND(-4) + [MA(4)=C(5), BACKCAST=1997:2]
\]

2.12. ARMA PC2 regression

\[
PC2 = C(1) + C(2)\times DUMMY2 + [AR(4)=C(3), MA(4)=C(4), BACKCAST=1997:2]
\]

2.13. ARMA PC2 regression (post-crisis sample)

\[
PC2 = C(1) + [AR(1)=C(2), MA(4)=C(3), BACKCAST=1999Q1]
\]
Table 2.1. Industry Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real industrial value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.23%</td>
<td>5.18%</td>
<td></td>
</tr>
<tr>
<td>Real industrial production</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.10%</td>
<td>4.80%</td>
<td></td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.1</td>
<td>Full</td>
<td>No</td>
<td>7.37%</td>
<td>5.27%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>2.2</td>
<td>Full</td>
<td>No</td>
<td>7.49%</td>
<td>5.21%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.3</td>
<td>Full</td>
<td>Yes</td>
<td>7.47%</td>
<td>5.46%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>2.4</td>
<td>Full</td>
<td>No</td>
<td>10.89%</td>
<td>8.81%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real ruble/dollar exchange rate</td>
<td>2.5</td>
<td>Full</td>
<td>No</td>
<td>5.00%</td>
<td>6.89%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Freight transport’n</td>
<td>2.6</td>
<td>Full</td>
<td>No</td>
<td>4.94%</td>
<td>4.74%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>2.7</td>
<td>Full</td>
<td>Yes</td>
<td>7.56%</td>
<td>5.72%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.10</td>
<td>Post-crisis</td>
<td>N/A</td>
<td>6.86%</td>
<td>4.57%</td>
</tr>
</tbody>
</table>
### Table 2.2. Industry Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real industrial value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5.18%</td>
<td></td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.8</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>5.28%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>2.9</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>5.48%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.1</td>
<td>Full</td>
<td>No</td>
<td>Yes</td>
<td>6.13%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.1</td>
<td>Full</td>
<td>No</td>
<td>Yes</td>
<td>5.99%</td>
</tr>
</tbody>
</table>

Notes: * PC2 is forecasted from the post-crisis sample
3. Construction

Variables

The dependent variable: real construction value-added, the difference of the logarithms of the year-over-year indices – DLCONSTRVA

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real industrial production
- Real retail sales
- Real fixed investment
- Freight transportation (in tons-kilometers)
- Cement production (in physical units)
- Employment
- Exports to CIS (in U.S. dollars)
- Imports from CIS (in U.S. dollars)
- Exports outside CIS (in U.S. dollars)
- Imports from outside CIS (in U.S. dollars)
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of consolidated government budget expenditures to revenues
- Real gross per capita household income
- Ratio of consumer prices to construction prices
- Ratio of freight transportation prices to construction prices
- Ratio of construction prices to industrial producer prices
- Brent crude oil spot price (in U.S. dollars)
Real Construction Value-Added Regressions

3.1. Regression of real construction value-added on principal components

\[ DLCONSTRVA = C(1) + C(2)*DLCONSTRVA(-4) + C(3)*PC1(-1) + C(4)*PC2(-1) + \\
C(5)*PC6(-1) + C(6)*PC1(-3) + \\
[AR(1)=C(7),AR(3)=C(8),MA(4)=C(9),BACKCAST=1998Q1] \]

Figure 3.1. Regression 3.1: Actual (Official) Values, Fitted Values and Residuals
3.2. Regression of real construction value-added on principal components (post-crisis sample)

\[ DLCONSTRVA = C(1) + C(2)\cdot PC1(-1) + C(3)\cdot PC6(-1) + C(4)\cdot PC1(-3) + [AR(1)=C(5), AR(3)=C(6), MA(4)=C(7), BACKCAST=2000Q2] \]

Dependent Variable: DLCONSTRVA
Method: Least Squares

Sample (adjusted): 2000Q2 2004Q3
Included observations: 18 after adjustments
Convergence achieved after 17 iterations
Backcast: 1999Q2 2000Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.003277</td>
<td>0.002251</td>
<td>-1.455458</td>
<td>0.1735</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.064330</td>
<td>0.015707</td>
<td>-4.095609</td>
<td>0.0018</td>
</tr>
<tr>
<td>PC6(-1)</td>
<td>-0.069991</td>
<td>0.022565</td>
<td>-3.101758</td>
<td>0.0101</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>0.039403</td>
<td>0.014789</td>
<td>2.664343</td>
<td>0.0220</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.497257</td>
<td>0.196501</td>
<td>-2.530550</td>
<td>0.0279</td>
</tr>
<tr>
<td>AR(3)</td>
<td>-0.359507</td>
<td>0.154718</td>
<td>-2.323627</td>
<td>0.0403</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.990023</td>
<td>0.026419</td>
<td>-37.47406</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.873369  Mean dependent var -0.004072
Adjusted R-squared 0.804298  S.D. dependent var 0.048527
S.E. of regression 0.021468  Akaike info criterion -4.559239
Sum squared resid 0.005069  Schwarz criterion -4.212983
Log likelihood 48.03315  F-statistic 12.64443
Durbin-Watson stat 2.363074  Prob(F-statistic) 0.000225

Inverted AR Roots .21+.59i .21-.59i -.92
Inverted MA Roots 1.00 .00+1.00i -.00-1.00i -1.00
Table 3.1. Construction Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real construction value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>14.66%</td>
<td>6.72%</td>
<td></td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>3.1</td>
<td>Full</td>
<td>No</td>
<td>13.48%</td>
<td>14.54%</td>
<td></td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>3.2</td>
<td>Post-crisis</td>
<td>N/A</td>
<td>14.48%</td>
<td>7.86%</td>
<td></td>
</tr>
</tbody>
</table>
4. Agriculture

Variables

The dependent variable: real agriculture value-added, the difference of the logarithms of the year-over-year indices – DLAGRVA

The special variable: real agricultural production, the difference of the logarithms of the year-over-year indices – DLAGR

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real construction
- Real retail sales
- Real inventories in retail sales
- Freight transportation (in tons-kilometers)
- Bread and bread product production (in physical units)
- Butter production (in physical units)
- Flour production (in physical units)
- Meat production (in physical units)
- Milk production (in physical units)
- Vegetable oil production (in physical units)
- Sugar production (in physical units)
- Exports to CIS (in U.S. dollars)
- Exports outside CIS (in U.S. dollars)
- Imports from CIS (in U.S. dollars)
- Imports from outside CIS (in U.S. dollars)
- Employment
- Real average wages
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of consolidated government budget expenditures to revenues
- Ratio of consumer prices to animal husbandry producer prices
- Ratio of industrial producer prices to animal husbandry producer prices
- Brent crude oil spot price (in U.S. dollars)
Agriculture Value-Added Regressions

4.1. Regression of real agriculture value-added on real agricultural production and principal components

\[ DLAGRVA = C(1) + C(2) \cdot DLAGR + C(3) \cdot DLAGR(-2) + C(4) \cdot DUMMYDLAGR(-2) + C(5) \cdot PC5 + C(6) \cdot DUMMYPC8 + \]
\[ AR(1)=C(7), AR(2)=C(8), MA(4)=C(9), BACKCAST=1997Q2 \]

Dependent Variable: DLAGRVA
Method: Least Squares

Sample (adjusted): 1997Q2 2004Q3
Included observations: 30 after adjustments
Convergence achieved after 9 iterations
Backcast: 1996Q2 1997Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.003348</td>
<td>0.003261</td>
<td>-1.026528</td>
<td>0.3163</td>
</tr>
<tr>
<td>DLAGR</td>
<td>0.992657</td>
<td>0.080936</td>
<td>12.26476</td>
<td>0.0000</td>
</tr>
<tr>
<td>DLAGR(-2)</td>
<td>-0.678167</td>
<td>0.095233</td>
<td>-7.121146</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMYDLAGR(-2)</td>
<td>0.543316</td>
<td>0.130296</td>
<td>4.169870</td>
<td>0.0004</td>
</tr>
<tr>
<td>PC5</td>
<td>-0.012020</td>
<td>0.003046</td>
<td>-3.945699</td>
<td>0.0007</td>
</tr>
<tr>
<td>DUMMYPC8</td>
<td>-0.012411</td>
<td>0.004760</td>
<td>-2.607336</td>
<td>0.0164</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-1.045177</td>
<td>0.142375</td>
<td>-7.340989</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.623626</td>
<td>0.145893</td>
<td>-4.274553</td>
<td>0.0003</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.989920</td>
<td>0.114819</td>
<td>8.621570</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared       | 0.967568    | Mean dependent var | 0.004252 |
Adjusted R-squared | 0.955213    | S.D. dependent var  | 0.114200 |
S.E. of regression | 0.024151    | Akaike info criterion | -4.365645 |
Sum squared resid  | 0.012249    | Schwarz criterion    | -3.945285 |
Log likelihood    | 74.48467    | F-statistic          | 78.31320 |
Durbin-Watson stat | 2.305426    | Prob(F-statistic)    | 0.000000 |

Inverted AR Roots | -.52-.59i   | -.52+.59i |
Inverted MA Roots | .71+.71i    | .71+.71i | -.71-.71i | -.71-.71i |
4.2. Regression of real agriculture value-added on real agricultural production and principal components (without crisis dummies)

\[ DLAGRVA = C(1) + C(2)*DLAGR + C(3)*DLAGR(-2) + C(4)*PC5 + C(5)*PC8 + \]
\[ [AR(1)=C(6),AR(2)=C(7),MA(4)=C(8),BACKCAST=1997Q2] \]

4.3. Regression of real agriculture value-added on real agricultural production

\[ DLAGRVA = C(1) + C(2)*DLAGR + C(3)*DLAGR(-2) + C(4)*DUMMYDLAGR(-2) + \]
\[ C(5)*DLAGR(-4) + [AR(1)=C(6),AR(2)=C(7),MA(4)=C(8),BACKCAST=1997Q4] \]

4.4. Regression of real agriculture value-added on Brent crude oil spot price

\[ DLAGRVA = C(1) + C(2)*DLAGRVA(-1) + C(3)*DUMMYDLAGRVA(-1) + \]
\[ C(4)*DLAGRVA(-2) + C(5)*DUMMYDLAGRVA(-2) + C(6)*DLBRENT(-3) + \]
\[ C(7)*DLBRENT(-4) + [AR(3)=C(8),MA(4)=C(9),BACKCAST=1998Q1] \]

4.5. Regression of real agriculture value-added on real industrial production

\[ DLAGRVA = C(1) + C(2)*DLIND + C(3)*DUMMYDLIND(-1) + C(4)*DLIND(-2) + \]
\[ [AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997Q2] \]

4.6. Regression of real agriculture value-added on freight transportation

\[ DLAGRVA = C(1) + C(2)*DUMMY2 + C(3)*DLAGRVA(-1) + \]
\[ C(4)*DUMMYDLAGRVA(-1) + C(5)*DLAGRVA(-2) + C(6)*DUMMYDLAGRVA(-2) + \]
\[ C(7)*DLTRANSPORT(-1) + C(8)*DLTRANSPORT(-4) + \]
\[ [AR(2)=C(9),AR(3)=C(10),MA(4)=C(11),BACKCAST=1998Q1] \]

4.7. Regression of real agriculture value-added on real M2

\[ DLAGRVA = C(1) + C(2)*DLAGRVA(-2) + C(3)*DUMMYDLAGRVA(-2) + \]
\[ C(4)*DLREALM2 + C(5)*DUMMYDLREALM2 + C(6)*DLREALM2(-1) + \]
\[ C(7)*DLREALM2(-2) + [AR(1)=C(8),AR(2)=C(9),AR(3)=C(10),MA(4)=C(11),BACKCAST=1997Q3] \]

4.8. Regression of real agriculture value-added on real agricultural production and principal components (no contemporaneous independent variables)

\[ DLAGRVA = C(1) + C(2)*DLAGR(-2) + C(3)*DUMMYDLAGR(-2) + C(4)*DLAGR(-4) + C(5)*PC1(-1) + [AR(1)=C(6),AR(2)=C(7),MA(4)=C(8),BACKCAST=1997Q4] \]
4.9. Regression of real agriculture value-added on real agricultural production and principal components (no contemporaneous independent variables, no crisis dummy variables)

\[ DLAGRVA = C(1) + C(2) \times DLAGR(-2) + C(3) \times DLAGR(-4) + C(4) \times PC1(-1) + [AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997Q4] \]

4.10. Regression of real agriculture value-added on real agricultural production and principal components (no contemporaneous independent variables, no principal components)

\[ DLAGRVA = C(1) + C(2) \times DLAGR(-2) + C(3) \times DUMMYDLAGR(-2) + C(4) \times DLAGR(-4) + [AR(1)=C(5),MA(4)=C(6),BACKCAST=1997Q3] \]

4.11. ARMA real agricultural production regression

\[ DLAGR = C(1) + C(2) \times DUMMYDLAGR(-1) + C(3) \times DLAGR(-4) + [AR(1)=C(4),AR(2)=C(5),AR(3)=C(6),MA(4)=C(7),BACKCAST=1998Q1] \]

4.12. ARMA PC5 regression

\[ DUMMY5 = 1 \text{ for } 1999Q1, = 0 \text{ otherwise} \]

\[ PC5 = C(1) + C(2) \times DUMMY2 + C(3) \times DUMMY5 + C(4) \times PC5(-1) + C(5) \times PC5(-4) + [AR(4)=C(6)] \]

4.13. ARMA PC8 regression

\[ PC8 = C(1) + C(2) \times PC8(-2) + C(3) \times PC8(-3) + [AR(4)=C(4),MA(5)=C(5),BACKCAST=1998Q1] \]

4.14. ARMA PC5 regression (post-crisis sample)

\[ PC5 = C(1) + C(2) \times PC5(-1) + C(3) \times PC5(-4) + [AR(4)=C(4)] \]

4.15. ARMA PC8 regression (post-crisis sample)

\[ PC8 = C(1) + C(2) \times PC8(-3) + [MA(5)=C(3),BACKCAST=1999Q3] \]
Table 4.1. Agriculture Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agriculture value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.00%</td>
<td>4.87%</td>
</tr>
<tr>
<td>Real agricultural production</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-1.20%</td>
<td>2.40%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.1</td>
<td>Full</td>
<td>Yes</td>
<td>-0.01%</td>
<td>4.91%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.2</td>
<td>Full</td>
<td>No</td>
<td>-1.49%</td>
<td>6.00%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production</td>
<td>4.3</td>
<td>Full</td>
<td>Yes</td>
<td>0.26%</td>
<td>4.00%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>4.4</td>
<td>Full</td>
<td>Yes</td>
<td>14.76%</td>
<td>0.21%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>4.5</td>
<td>Full</td>
<td>Yes</td>
<td>3.75%</td>
<td>7.43%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Freight transportation</td>
<td>4.6</td>
<td>Full</td>
<td>Yes</td>
<td>8.15%</td>
<td>0.46%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>4.7</td>
<td>Full</td>
<td>Yes</td>
<td>0.11%</td>
<td>4.69%</td>
</tr>
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</table>
Table 4.2. Agriculture Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agriculture value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.87%</td>
<td></td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.8</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>4.81%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.9</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>7.97%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production</td>
<td>4.10</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>1.72%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.1</td>
<td>Full</td>
<td>Yes</td>
<td>Yes</td>
<td>6.10%</td>
</tr>
<tr>
<td>Real agriculture value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.1</td>
<td>Full*</td>
<td>Yes</td>
<td>Yes</td>
<td>6.06%</td>
</tr>
</tbody>
</table>

Note: * PC5 and PC8 are forecasted on the basis of the post-crisis sample
5. Trade

Variables

The dependent variable: real retail trade, wholesale trade, and catering value-added, the difference of the logarithms of the year-over-year indices – DLTRADE

Special indicator: real retail sales, the difference of the logarithms of the year-over-year indices – DLRETSales

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Freight transportation in tons-kilometers
- Real inventories in retail sales
- Real per capita household consumption of goods and services
- Bread and bread product production (in physical units)
- Car production (in physical units)
- Crude oil production (in physical units)
- Natural gas production (in physical units)
- Gasoline production (in physical units)
- Meat production (in physical units)
- Textile production (in physical units)
- Television set production (in physical units)
- Real ruble/U.S. dollar exchange rate
- Ratio of merchandise exports to imports (in U.S. dollars)
- Real M2
- Real average wage
- Ratio of consumer prices to industrial producer prices
- Ratio of freight transportation prices to industrial producer prices
- Ratio of construction prices to industrial producer prices
- Brent crude oil spot price (in U.S. dollars)
Trade Value-Added Regressions

5.1. Regression of real trade value-added on real retail sales and principal components

\[ DLTRADEVA = C(1) + C(2) \times DLRETSALES(-1) + C(3) \times DLRETSALES(-4) + C(4) \times PC1 + C(5) \times DUMMYPC1 + C(6) \times PC8 + C(7) \times DUMMYPC1(-4) + [AR(1)=C(8), MA(4)=C(9), BACKCAST=1997:3] \]

Dependent Variable: DLTRADEVA
Method: Least Squares

Sample(adjusted): 1997:3 2004:3
Included observations: 29 after adjusting endpoints
Convergence achieved after 36 iterations
Backcast: 1996:3 1997:2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
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<td>0.007497</td>
<td>0.003337</td>
<td>2.246859</td>
<td>0.0361</td>
</tr>
<tr>
<td>DLRETSALES(-1)</td>
<td>0.204098</td>
<td>0.044153</td>
<td>4.622579</td>
<td>0.0002</td>
</tr>
<tr>
<td>DLRETSALES(-4)</td>
<td>-0.405358</td>
<td>0.050885</td>
<td>-7.966227</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.012542</td>
<td>0.002809</td>
<td>-4.465559</td>
<td>0.0002</td>
</tr>
<tr>
<td>DUMMYPC1</td>
<td>0.007624</td>
<td>0.004819</td>
<td>1.582196</td>
<td>0.1293</td>
</tr>
<tr>
<td>PC8</td>
<td>0.032991</td>
<td>0.004104</td>
<td>8.038276</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMYPC1(-4)</td>
<td>0.006666</td>
<td>0.002202</td>
<td>3.026758</td>
<td>0.0067</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.652057</td>
<td>0.193055</td>
<td>-3.377566</td>
<td>0.0030</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.951198</td>
<td>0.030069</td>
<td>31.63391</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.909159
Adjusted R-squared: 0.872823
S.E. of regression: 0.014782
Sum squared resid: 0.004370
Log likelihood: 86.45372
Durbin-Watson stat: 2.086103

Inverted AR Roots: -.65
Inverted MA Roots: .70+.70i, .70+.70i, -.70-.70i, -.70-.70i
5.2. Regression of real trade value-added on real retail sales

\[ DLTRADEVA = C(1) + C(2) * DLRETAILSALES(-2) + C(3) * DLRETAILSALES(-3) + C(4) * DLRETAILSALES(-4) + [AR(2)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998:2]\]

5.3. Regression of real trade value-added on real retail sales and principal components (no crisis dummies)

\[ DLTRADEVA = C(1) + C(2) * DLRETAILSALES(-1) + C(3) * DLRETAILSALES(-4) + C(4) * PC1 + C(5) * PC8 + C(6) * PC1(-4) + [AR(1)=C(7),MA(4)=C(8),BACKCAST=1997Q3]\]

5.4. Regression of real trade value-added on Brent crude oil spot price

\[ DLTRADEVA = C(1) + C(2) * DLBRENT + C(3) * DLBRENT(-1) + C(4) * DLBRENT(-2) + [AR(4)=C(5),MA(1)=C(6),MA(3)=C(7),MA(4)=C(8),BACKCAST=1997Q4]\]

5.5. Regression of real trade value-added on the real ruble/U.S. dollar exchange rate

\[ DLTRADEVA = C(1) + C(2) * DUMMY2 + C(3) * DLREALEXRATE + C(4) * DLREALEXRATE(-2) + C(5) * DLREALEXRATE(-3) + [AR(3)=C(6),MA(3)=C(7),BACKCAST=1997:4]\]

5.6. Regression of real trade value-added on the real retail sales inventories

\[ DLTRADEVA = C(1) + C(2) * DLREALINVENT + C(3) * DLREALINVENT(-1) + C(4) * DLREALINVENT(-3) + [AR(1)=C(5),AR(3)=C(6),AR(4)=C(7),MA(1)=C(8),MA(4)=C(9),BACKCAST=1998Q1]\]

5.7. Regression of real trade value-added on the real average wages

\[ DLTRADEVA = C(1) + C(2) * DLTRADEVA(-2) + C(3) * DLREALWAGE + C(4) * DLREALWAGE(-2) + [AR(2)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1997:4]\]

5.8. Regression of real trade value-added on real retail sales and principal components (no contemporaneous independent variables, no crisis dummies)

\[ DLTRADEVA = C(1) + C(2) * DLRETAILSALES(-4) + C(3) * PC1(-2) + C(4) * PC1(-3) + [AR(2)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998:2]\]

5.9. Regression of real trade value-added on real retail sales and principal components (no contemporaneous independent variables)

\[ DLTRADEVA = C(1) + C(2) * DUMMY2 + C(3) * DLRETAILSALES(-4) + C(4) * PC1(-2) + C(5) * PC1(-3) + [AR(2)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1998:2]\]

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5.10. ARMA PC1 regression

\[ PC1 = C(1) + C(2)*DUMMY8 + C(3)*DUMMY9 + C(4)*DUMMYPC1(-1) + [MA(4)=C(5),BACKCAST=1996Q3] \]

5.11. ARMA PC8 regression

\[ PC8 = C(1) + C(2)*PC8(-2) + C(3)*PC8(-3) + [AR(4)=C(4),MA(4)=C(5),BACKCAST=1998:1] \]
Table 5.1. Trade Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real trade value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.29%</td>
<td>10.42%</td>
</tr>
<tr>
<td>Real retail sales</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.70%</td>
<td>12.50%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail sales and PCs</td>
<td>5.1</td>
<td>Full</td>
<td>Yes</td>
<td>10.07%</td>
<td>10.53%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>5.2</td>
<td>Full</td>
<td>No</td>
<td>9.92%</td>
<td>9.79%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail sales and PCs</td>
<td>5.3</td>
<td>Full</td>
<td>No</td>
<td>9.30%</td>
<td>9.73%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>5.4</td>
<td>Full</td>
<td>No</td>
<td>11.57%</td>
<td>11.55%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real ruble/dollar exchange rate</td>
<td>5.5</td>
<td>Full</td>
<td>Yes</td>
<td>6.87%</td>
<td>6.33%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail sales inventories</td>
<td>5.6</td>
<td>Full</td>
<td>Yes</td>
<td>13.48%</td>
<td>11.55%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real average wages</td>
<td>5.7</td>
<td>Full</td>
<td>Yes</td>
<td>6.92%</td>
<td>5.24%</td>
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</table>
Table 5.2. Trade Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real trade value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.42%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail sales and PCs</td>
<td>5.8</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>10.39%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>5.2</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>10.61%</td>
</tr>
<tr>
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<td>Forecast</td>
<td>Real retail sales and PCs</td>
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<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>10.70%</td>
</tr>
<tr>
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<td>Forecast</td>
<td>Real retail sales and PCs</td>
<td>5.1</td>
<td>Full</td>
<td>Yes</td>
<td>Yes</td>
<td>10.95%</td>
</tr>
</tbody>
</table>
6. Transportation

Variables

The dependent variable: real transportation and communication value-added, the difference of the logarithms of the year-over-year indices – DLTRANSPVA

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real retail sales
- Freight transportation (in tons-kilometers)
- Coal production (in physical units)
- Crude oil production (in physical units)
- Finished rolled metal production (in physical units)
- Mineral fertilizer production (in physical units)
- Natural gas production (in physical units)
- Truck production (in physical units)
- Wood production (in physical units)
- Employment
- Exports to CIS (in U.S. dollars)
- Imports from CIS (in U.S. dollars)
- Exports outside CIS (in U.S. dollars)
- Imports from outside CIS (in U.S. dollars)
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of freight transportation prices to industrial producer prices
- Ratio of freight transportation prices to construction prices
- Ratio of freight transportation prices to consumer prices
- Brent crude oil spot price (in U.S. dollars)
## Transportation Regressions

### 6.1. Regression of real transportation value-added on principal components

\[ DLTRANSPVA = C(1) + C(2) \cdot PC1 + C(3) \cdot PC6 + C(4) \cdot PC1(-2) +\]
\[ AR(1) = C(5), AR(4) = C(6), MA(2) = C(7), MA(4) = C(8), BACKCAST = 1997Q4 \]

Dependent Variable: DLTRANSPVA  
Method: Least Squares  
Sample (adjusted): 1997Q4 2004Q3  
Included observations: 28 after adjustments  
Convergence achieved after 18 iterations  
Backcast: 1996Q4 1997Q3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>0.005301</td>
<td>0.002528</td>
<td>2.096514</td>
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</tr>
<tr>
<td>PC1</td>
<td>0.010189</td>
<td>0.001482</td>
<td>6.874297</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC6</td>
<td>0.003907</td>
<td>0.003073</td>
<td>1.271232</td>
<td>0.2182</td>
</tr>
<tr>
<td>PC1(-2)</td>
<td>-0.017323</td>
<td>0.001609</td>
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<td>0.0000</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.513595</td>
<td>0.138299</td>
<td>-3.713660</td>
<td>0.0014</td>
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<tr>
<td>AR(4)</td>
<td>-0.325718</td>
<td>0.129838</td>
<td>-2.508653</td>
<td>0.0208</td>
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<tr>
<td>MA(2)</td>
<td>0.633229</td>
<td>0.050434</td>
<td>12.55558</td>
<td>0.0000</td>
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<tr>
<td>MA(4)</td>
<td>0.970843</td>
<td>0.039240</td>
<td>24.74086</td>
<td>0.0000</td>
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</table>

| R-squared | 0.903426 | Mean dependent var | 0.004276 |
| Adjusted R-squared | 0.869625 | S.D. dependent var | 0.027390 |
| S.E. of regression | 0.009890 | Akaike info criterion | -6.159652 |
| Sum squared resid | 0.001956 | Schwarz criterion | -5.779023 |
| Log likelihood | 94.23513 | F-statistic | 26.72773 |
| Durbin-Watson stat | 2.086612 | Prob(F-statistic) | 0.000000 |

Inverted AR Roots  
0.43+.52i  0.43-.52i  -.68-.50i  -.68+.50i

Inverted MA Roots  
0.58+.81i  0.58-.81i  -.58+.81i  -.58-.81i

268
6.2. Regression of real transportation value-added on principal components
(including a crisis dummy variable)

\[ DLTRANSPVA = C(1) + C(2) \cdot PC1 + C(3) \cdot DUMMYPC1 + C(4) \cdot PC6 + C(5) \cdot PC1(-2) \]
\[ + [AR(1)=C(6),MA(2)=C(7),BACKCAST=1997Q1] \]

6.3. Regression of real transportation value-added on freight transportation in tons-kilometers

\[ DLTRANSPVA = C(1) + C(2) \cdot DLTRANSPORT + C(3) \cdot DLTRANSPVA(-3) + 
C(4) \cdot DUMDLTRANSPVA(-3) + 
[AR(1)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q1] \]

6.4. Regression of real transportation value-added on Brent crude oil spot price

\[ DLTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot DLTRANSPVA(-1) + 
C(4) \cdot DUMDLTRANSPVA(-2) + C(5) \cdot DLTRANSPVA(-3) + C(6) \cdot DUMMYDLBRENT + 
[AR(4)=C(7),MA(4)=C(8),BACKCAST=1998Q1] \]

6.5. Regression of real transportation value-added on real construction

\[ DLTRANSPVA = C(1) + C(2) \cdot DLTRANSPVA(-1) + C(3) \cdot DLCONSTR + 
C(4) \cdot DUMMYDLCONSTR + C(5) \cdot DLTRANSPVA(-3) + C(6) \cdot DUMMYDLCONSTR(-3) + 
C(7) \cdot DLTRANSPVA(-4) + [AR(1)=C(8),AR(4)=C(9),MA(4)=C(10),BACKCAST=1998Q2] \]

6.6. Regression of real transportation value-added on crude oil production

\[ DLTRANSPVA = C(1) + C(2) \cdot DLTRANSPVA(-1) + C(3) \cdot DLTRANSPVA(-3) + 
C(4) \cdot DUMMYDLCRUDEOIL + C(5) \cdot DUMMYDLCRUDEOIL(-1) + 
C(6) \cdot DLTRANSPVA(-3) + C(7) \cdot DRCRUDEOIL(-2) + [AR(4)=C(8),MA(4)=C(9),BACKCAST=1998Q2] \]

6.7. Regression of real transportation value-added on natural gas production

\[ DLTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot DLTRANSPVA(-4) + C(4) \cdot DLGAS + 
[AR(1)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q2] \]

6.8. Regression of real transportation value-added on real M2

\[ DLTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot DLTRANSPVA(-3) + 
C(4) \cdot DLREALM2(-1) + [AR(1)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q1] \]

6.9. Regression of real transportation value-added on real agricultural production

\[ DLTRANSPVA = C(1) + C(2) \cdot DLTRANSPVA(-4) + C(3) \cdot DUMMYDLAGR + 
C(4) \cdot DLTRANSPVA(-1) + C(5) \cdot DLTRANSPVA(-2) + C(6) \cdot DUMMYDLAGR(-2) + C(7) \cdot DLTRANSPVA(-3) + 
[AR(1)=C(8),MA(4)=C(9),BACKCAST=1997Q3] \]
6.10. Regression of real transportation value-added on principal components (no contemporaneous independent variables)

\[ DLTRANSPVA = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot DUMMYPC1(-1) + C(4) \cdot PC6(-1) + C(5) \cdot PC1(-2) +\]
\[ AR(1) = C(6), AR(4) = C(7), MA(2) = C(8), MA(4) = C(9), BACKCAST = 1997Q4 \]

6.11. Regression of real transportation value-added on principal components (no contemporaneous independent variables, no crisis dummy variables)

\[ DLTRANSPVA = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot PC6(-1) + C(4) \cdot PC1(-2) +\]
\[ AR(1) = C(5), AR(4) = C(6), MA(2) = C(7), MA(4) = C(8), BACKCAST = 1997Q4 \]

6.12. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \cdot DUMMY8 + C(3) \cdot DUMMY9 + C(4) \cdot PC1(-1) + C(5) \cdot PC1(-3) + C(6) \cdot DUMMYPC1(-3) + [MA(4) = C(7), BACKCAST = 1997Q1] \]

6.13. ARMA PC6 regression

\[ PC6 = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot PC6(-1) +\]
\[ AR(2) = C(4), AR(4) = C(5), MA(4) = C(6), BACKCAST = 1997Q3 \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real transportation value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.84%</td>
<td>10.13%</td>
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<tr>
<td>Freight transportation in tons-kilometers</td>
<td>Official</td>
<td>N/A</td>
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<td>N/A</td>
<td>N/A</td>
<td>7.08%</td>
<td>6.36%</td>
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<td>PCs</td>
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<td>No</td>
<td>10.37%</td>
<td>9.95%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>6.2</td>
<td>Full</td>
<td>Yes</td>
<td>7.94%</td>
<td>8.39%</td>
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<td>Freight transportation</td>
<td>6.3</td>
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<td>9.37%</td>
<td>7.51%</td>
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<td>Brent crude oil spot price</td>
<td>6.4</td>
<td>Full</td>
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<td>11.58%</td>
<td>11.70%</td>
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<tr>
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<td>Forecast</td>
<td>Real construction</td>
<td>6.5</td>
<td>Full</td>
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<td>1.89%</td>
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<td>Crude oil production</td>
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<td>Full</td>
<td>Yes</td>
<td>9.91%</td>
<td>9.60%</td>
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<td>Natural gas production</td>
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<td>Full</td>
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<td>9.05%</td>
<td>7.29%</td>
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<td>Forecast</td>
<td>Real M2</td>
<td>6.8</td>
<td>Full</td>
<td>Yes</td>
<td>11.56%</td>
<td>12.67%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Real agricultural production</td>
<td>6.9</td>
<td>Full</td>
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<td>10.19%</td>
<td>8.25%</td>
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Table 6.2. Transportation Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real transportation value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.13%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>6.10</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>10.27%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>6.11</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>10.26%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>6.1</td>
<td>Full</td>
<td>No</td>
<td>Yes</td>
<td>10.55%</td>
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7. Other Market Services

Variables

The dependent variable: real other market services value-added, the difference of the logarithms of the year-over-year indices – DLOMSVA

Special indicator: real paid consumer services, the difference of the logarithms of the year-over-year indices – DLPSERV

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real industrial production
- Real retail sales
- Real inventories in retail trade
- Freight transportation (in tons/kilometers)
- Real per capita consumer spending on goods and services
- Merchandise exports to CIS countries (in U.S. dollars)
- Merchandise exports to non-CIS countries (in U.S. dollars)
- Merchandise imports from CIS countries (in U.S. dollars)
- Merchandise imports from non-CIS countries (in U.S. dollars)
- Employment
- Real average wages
- Real ruble/U.S. dollar exchange rate
- Ratio of consolidated budget expenditures to consolidated budget revenues
- Ratio of defense expenditures to consolidated budget expenditures
- Real M2
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer services prices to consumer prices
- Brent crude oil spot price (in U.S. dollars)
## Other Market Services Regressions

### 7.1. Regression of real other market services on real paid consumer services and principal components

\[
DLOMSVA = C(1) + C(2) \times DLPSERV + C(3) \times PC3 + C(4) \times DUMMYPC3 + C(5) \times PC5 + C(6) \times PC1(-1) + C(7) \times PC3(-1) + \[AR(3)=C(8), MA(1)=C(9), MA(4)=C(10), BACKCAST=1997Q2\]
\]

Dependent Variable: DLOMSVA  
Method: Least Squares  
Sample (adjusted): 1997Q2 2004Q3  
Included observations: 30 after adjustments  
Convergence achieved after 10 iterations  
Backcast: 1996Q2 1997Q1

<table>
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<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<td>C</td>
<td>0.000896</td>
<td>0.003349</td>
<td>0.267649</td>
<td>0.7917</td>
</tr>
<tr>
<td>DLPSERV</td>
<td>0.471227</td>
<td>0.152265</td>
<td>3.094773</td>
<td>0.0057</td>
</tr>
<tr>
<td>PC3</td>
<td>0.023706</td>
<td>0.011523</td>
<td>2.057271</td>
<td>0.0529</td>
</tr>
<tr>
<td>DUMMYPC3</td>
<td>-0.026225</td>
<td>0.014487</td>
<td>-1.810247</td>
<td>0.0853</td>
</tr>
<tr>
<td>PC5</td>
<td>0.035089</td>
<td>0.011061</td>
<td>3.172427</td>
<td>0.0048</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>0.004434</td>
<td>0.001742</td>
<td>2.545786</td>
<td>0.0193</td>
</tr>
<tr>
<td>PC3(-1)</td>
<td>-0.014058</td>
<td>0.006836</td>
<td>-2.056404</td>
<td>0.0530</td>
</tr>
<tr>
<td>AR(3)</td>
<td>-0.275549</td>
<td>0.172018</td>
<td>-1.601859</td>
<td>0.1249</td>
</tr>
<tr>
<td>MA(1)</td>
<td>-0.544546</td>
<td>0.208898</td>
<td>-2.606752</td>
<td>0.0169</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.649798</td>
<td>2.96E-05</td>
<td>21930.80</td>
<td>0.0000</td>
</tr>
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</table>

R-squared 0.842637  
Adjusted R-squared 0.771824  
S.E. of regression 0.020180  
Akaike info criterion -4.707058  
Schwarz criterion -4.239992  
F-statistic 11.89945  
Prob(F-statistic) 0.000003

Inverted AR Roots 0.33-.56i 0.33+.56i -.65  
Inverted MA Roots 0.79-.61i 0.79+.61i -0.52+.62i -0.52-.62i
7.2. Regression of real other market services on real paid consumer services and principal components (no crisis dummies)

\[ DLOMSVA = C(1) + C(2)\text{DLPSERV} + C(3)\text{PC3} + C(4)\text{PC5} + C(5)\text{PC1(-1)} + C(6)\text{PC3(-1)} + [\text{AR(3)}=C(7), \text{MA(1)}=C(8), \text{MA(4)}=C(9), \text{BACKCAST}=1997Q2] \]

7.3. Regression of real other market services on real paid consumer services

\[ DLOMSVA = C(1) + C(2)\text{DLPSERV} + C(3)\text{DLPSERV(-4)} + [\text{AR(4)}=C(4), \text{MA(4)}=C(5), \text{BACKCAST}=1998Q2] \]

7.4. Regression of real other market services on real retail sales

\[ DLOMSVA = C(1) + C(2)\text{DLRETSales} + C(3)\text{DLRETSales(-4)} + [\text{MA}(1)=C(4), \text{BACKCAST}=1996Q3] \]

7.5. Regression of real other market services on Brent crude oil spot price (post-crisis sample)

\[ DLOMSVA = C(1) + C(2)\text{DLBRENT(-3)} + [\text{AR(3)}=C(3), \text{MA}(2)=C(4), \text{MA}(4)=C(5), \text{BACKCAST}=2000Q2] \]

7.6. Regression of real other market services on real M2 (post-crisis sample)

\[ DLOMSVA = C(1) + C(2)\text{DLREALM2(-2)} + [\text{AR(3)}=C(3), \text{MA}(4)=C(4), \text{BACKCAST}=2000Q1] \]

7.7. Regression of real other market services on real per capita consumer spending on goods and services (post-crisis sample)

\[ DLOMSVA = C(1) + C(2)\text{DLREALPCCONS} + C(3)\text{DLREALPCCONS(-3)} + [\text{AR(2)}=C(4), \text{AR}(3)=C(5), \text{MA}(2)=C(6), \text{BACKCAST}=2000Q2] \]

7.8. Regression of real other market services on principal components (no contemporaneous independent variables)

\[ DLOMSVA = C(1) + C(2)\text{PC1(-1)} + C(3)\text{PC2(-1)} + C(4)\text{PC3(-1)} + C(5)\text{PC1(-2)} + C(6)\text{PC1(-3)} + C(7)\text{PC1(-4)} + [\text{MA}(1)=C(8), \text{BACKCAST}=1997Q2] \]

7.9. Regression of real other market services on principal components (no contemporaneous independent variables; a crisis dummy variable is included)

\[ DLOMSVA = C(1) + C(2)\text{PC1(-1)} + C(3)\text{DUMMYPC2(-1)} + C(4)\text{PC3(-1)} + C(5)\text{PC1(-2)} + C(6)\text{PC1(-3)} + C(7)\text{PC1(-4)} + [\text{MA}(1)=C(8), \text{BACKCAST}=1997Q2] \]
7.10. Regression of real other market services on real paid consumer services and principal components (no contemporaneous independent variables)

\[
DLOMSVA = C(1) + C(2)*DLPSERV(-1) + C(3)*PC1(-1) + C(4)*PC2(-1) + C(5)*PC3(-1) + C(6)*PC1(-2) + C(7)*PC1(-3) + C(8)*PC1(-4) + [MA(1)=C(9),BACKCAST=1997Q2]
\]

7.11. ARMA regression of real paid consumer services

\[
DLPSERV = C(1) + C(2)*DUMMY2 + C(3)*DLPSERV(-2) + [AR(4)=C(4),MA(1)=C(5),MA(2)=C(6),BACKCAST=1997Q4]
\]

7.12. ARMA PC3 regression

\[
PC3 = C(1) + C(2)*DUMMY2 + C(3)*PC3(-1) + [AR(4)=C(4),MA(4)=C(5),BACKCAST=1997Q3]
\]

7.13. ARMA PC5 regression

\[
PC5 = C(1) + C(2)*PC5(-2) + C(3)*PC5(-3) + [MA(3)=C(4),BACKCAST=1997Q1]
\]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other market services value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.09%</td>
<td>6.77%</td>
<td></td>
</tr>
<tr>
<td>Real paid consumer services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.10%</td>
<td>9.20%</td>
<td></td>
</tr>
<tr>
<td>Real other market services value-added</td>
<td>Forecast</td>
<td>Real paid consumer services and PCs</td>
<td>7.1</td>
<td>Full</td>
<td>Yes</td>
<td>3.97%</td>
<td>6.41%</td>
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<td>Real paid consumer services and PCs</td>
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<td>Full</td>
<td>No</td>
<td>3.49%</td>
<td>6.20%</td>
</tr>
<tr>
<td>Real other market services value-added</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>7.3</td>
<td>Full</td>
<td>No</td>
<td>3.64%</td>
<td>4.36%</td>
</tr>
<tr>
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<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>7.5</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>3.28%</td>
<td>1.96%</td>
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<tr>
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<td>Real M2</td>
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<td>N/A</td>
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<tr>
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<td>Post-Crisis</td>
<td>N/A</td>
<td>4.23%</td>
<td>4.79%</td>
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</table>
Table 7.2. Other Market Services Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
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<tbody>
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<td>Real non-market services value-added</td>
<td>Official</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.77%</td>
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<tr>
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<td>Forecast</td>
<td>PCs</td>
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<td>No</td>
<td>5.32%</td>
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<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>7.9</td>
<td>Full</td>
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<td>No</td>
<td>5.10%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Real paid consumer services and PCs</td>
<td>7.10</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>5.11%</td>
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<tr>
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<td>Forecast</td>
<td>Real paid consumer services and PCs</td>
<td>7.1</td>
<td>Full</td>
<td>Yes</td>
<td>Yes</td>
<td>5.28%</td>
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</tbody>
</table>
8. Non-Market Services

Variables

The dependent variable: real non-market services value-added, the difference of the logarithms of the year-over-year indices – DLNMSVA

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real industrial production
- Real retail sales
- Real inventories in retail trade
- Freight transportation (in tons/kilometers)
- Real per capita consumer spending on goods and services
- Merchandise exports to CIS countries (in U.S. dollars)
- Merchandise exports to non-CIS countries (in U.S. dollars)
- Merchandise imports from CIS countries (in U.S. dollars)
- Merchandise imports from non-CIS countries (in U.S. dollars)
- Employment
- Real average wages
- Real ruble/U.S. dollar exchange rate
- Ratio of consolidated budget expenditures to consolidated budget revenues
- Ratio of defense expenditures to consolidated budget expenditures
- Real M2
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer services prices to consumer prices
- Brent crude oil spot price (in U.S. dollars)
Non-Market Services Value-Added Regressions

8.1. Regression of real non-market services value-added on principal components

\[ DLNMSVA = C(1) + C(2)\times DLNMSVA(-2) + C(3)\times PC7(-1) + C(4)\times PC7(-2) + C(5)\times PC1(-3) + C(6)\times PC7(-3) + C(7)\times PC3(-4) + [AR(3)=C(8), AR(4)=C(9), MA(4)=C(10), BACKCAST=1998Q2] \]

Dependent Variable: DLNMSVA
Method: Least Squares

Sample (adjusted): 1998Q2 2004Q3
Included observations: 26 after adjustments
Convergence achieved after 22 iterations
Backcast: 1997Q2 1998Q1

<table>
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<th>Variable</th>
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<tr>
<td>C</td>
<td>0.001634</td>
<td>0.000990</td>
<td>1.650273</td>
<td>0.1184</td>
</tr>
<tr>
<td>DLNMSVA(-2)</td>
<td>0.271930</td>
<td>0.103962</td>
<td>2.615655</td>
<td>0.0187</td>
</tr>
<tr>
<td>PC7(-1)</td>
<td>0.017661</td>
<td>0.003549</td>
<td>4.976085</td>
<td>0.0001</td>
</tr>
<tr>
<td>PC7(-2)</td>
<td>-0.018312</td>
<td>0.003095</td>
<td>-5.917217</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>0.005871</td>
<td>0.000874</td>
<td>6.717515</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC7(-3)</td>
<td>-0.020969</td>
<td>0.002994</td>
<td>-7.003233</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC3(-4)</td>
<td>-0.012457</td>
<td>0.002306</td>
<td>-5.403015</td>
<td>0.0001</td>
</tr>
<tr>
<td>AR(3)</td>
<td>-0.298206</td>
<td>0.056724</td>
<td>-5.257145</td>
<td>0.0001</td>
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<tr>
<td>AR(4)</td>
<td>-0.546005</td>
<td>0.050302</td>
<td>-10.85448</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.983137</td>
<td>0.027955</td>
<td>35.16881</td>
<td>0.0000</td>
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</table>

R-squared 0.948124
Adjusted R-squared 0.918943
S.E. of regression 0.005133
Sum squared resid 0.000422
Log likelihood 106.4919
Durbin-Watson stat 2.099498

Inverted AR Roots .61+.70i .61-.70i -.61+.50i -.61-.50i
Inverted MA Roots .70+.70i .70+.70i .70-.70i .70-.70i
8.2. Regression of real non-market services value-added on principal components (a crisis dummy variable included)

\[ DLNMSVA = C(1) + C(2) * DLNMSVA(-2) + C(3) * DUMMYDLNMSVA(-2) + C(4) * PC7(-1) + C(5) * PC7(-2) + C(6) * PC1(-3) + C(7) * PC7(-3) + C(8) * PC3(-4) + [AR(3)=C(9), AR(4)=C(10), MA(4)=C(11), BACKCAST=1998Q2] \]

8.3. Regression of real non-market services value-added on Brent crude oil spot price

\[ DLNMSVA = C(1) + C(2) * DUMMY2 + C(3) * DLNMSVA(-2) + C(4) * DLBRENT(-3) + C(5) * DLBRENT(-4) + [AR(1)=C(6), AR(4)=C(7), MA(4)=C(8), BACKCAST=1998Q2] \]

8.4. Regression of real non-market services value-added on the ratio of consolidated government budget expenditures to revenues

\[ DLNMSVA = C(1) + C(2) * DLNMSVA(-2) + C(3) * DLCONSEXPREV(-3) + C(4) * DLCONSEXPREV(-4) + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q3] \]

8.5. Regression of real non-market services value-added on real retail sales

\[ DLNMSVA = C(1) + C(2) * DLNMSVA(-2) + C(3) * DLRETAILSALES + C(4) * DLRETAILSALES(-4) + [AR(1)=C(5), AR(4)=C(6), MA(4)=C(7), BACKCAST=1998Q1] \]

8.6. Regression of real non-market services value-added on real M2

\[ DLNMSVA = C(1) + C(2) * DLNMSVA(-1) + C(3) * DUMMYDLNMSVA(-1) + C(4) * DLNMSVA(-3) + C(5) * DLREALM2(-2) + [AR(4)=C(6), MA(4)=C(7), BACKCAST=1998Q1] \]

8.7. Regression of real non-market services value-added on real industrial production

\[ DLNMSVA = C(1) + C(2) * DUMMY2 + C(3) * DLIND(-1) + C(4) * DUMMYDLIND(-1) + [AR(1)=C(5), AR(3)=C(6), MA(2)=C(7), MA(4)=C(8), BACKCAST=1997Q2] \]

8.8. Regression of real non-market services value-added on the ratio of defense budget expenditures to total consolidated government budget expenditures

\[ DLNMSVA = C(1) + C(2) * DLDEFRAATIO(-4) + C(3) * DUMMYDLDEFRAATIO(-4) + [AR(1)=C(4), AR(4)=C(5), MA(4)=C(6), BACKCAST=1998Q2] \]

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8.9. Regression of real non-market services value-added on principal components (post-crisis sample)

$$DLNMSVA = C(1) + C(2) \times PC7(-1) + C(3) \times PC1(-3) + C(4) \times PC7(-3) + C(5) \times PC3(-4) + [AR(3) = C(6), AR(4) = C(7), MA(4) = C(8), BACKCAST = 2000Q4]$$
Table 8.1. Non-Market Services Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables (the sample is reduced by two quarters)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real non-market services value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2.37%</td>
<td>2.49%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.1</td>
<td>Full</td>
<td>No</td>
<td>2.58%</td>
<td>2.63%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.2</td>
<td>Full</td>
<td>Yes</td>
<td>2.08%</td>
<td>2.18%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>8.3</td>
<td>Full</td>
<td>Yes</td>
<td>3.35%</td>
<td>3.96%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Ratio of consolidated government budget expenditures to revenues</td>
<td>8.4</td>
<td>Full</td>
<td>No</td>
<td>2.92%</td>
<td>2.27%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>8.5</td>
<td>Full</td>
<td>No</td>
<td>2.89%</td>
<td>3.20%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>8.6</td>
<td>Full</td>
<td>Yes</td>
<td>2.11%</td>
<td>1.72%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>8.7</td>
<td>Full</td>
<td>Yes</td>
<td>1.95%</td>
<td>1.63%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>Ratio of defense budget expenditures to total consolidated government budget expenditures</td>
<td>8.8</td>
<td>Full</td>
<td>Yes</td>
<td>3.10%</td>
<td>2.66%</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-----</td>
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<td>-----</td>
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</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PC's</td>
<td>8.9</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>2.45%</td>
<td>3.46%</td>
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Table 8.2. Non-Market Services Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables (the sample is reduced by one quarter)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real non-market services value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2.49%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.1</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>2.48%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.2</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>2.47%</td>
</tr>
<tr>
<td>Real non-market services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.9</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>No</td>
<td>3.10%</td>
</tr>
</tbody>
</table>
9. Net Taxes on Products and Imports

Variables

The dependent variable: real net taxes on products and imports, the difference of the logarithms of the year-over-year indices – DLTAXPROD

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Freight transportation (in tons-kilometers)
- Real retail sales
- Real inventories in retail sales
- Car production
- Cement production
- Crude oil production
- Electricity production
- Mineral fertilizer production
- Natural gas production
- Steel production
- Employment
- Real ruble/U.S. exchange rate
- Ratio of merchandise exports to merchandise imports (in U.S. dollars)
- Real M2
- Real average wages
- Ratio of consumer prices to industrial producer prices
- Ratio of consolidated government budget expenditures to revenues
- Ratio of defense spending to total consolidated government budget expenditures
- Brent crude oil spot price
### 9.1. Regression of real net taxes on products and imports on principal components

\[
DLTAXPROD = C(1) + C(2)*PC1 + C(3)*PC2(-1) + C(4)*PC4(-1) + \\
C(5)*DUMMYPC4(-1) + C(6)*PC1(-2) \\
[AR(1)=C(7),AR(4)=C(8),MA(4)=C(9),BACKCAST=1997Q4]
\]

Dependent Variable: DLTAXPROD  
Method: Least Squares

Sample (adjusted): 1997Q4 2004Q3  
Included observations: 28 after adjustments  
Failure to improve SSR after 16 iterations  
Backcast: 1996Q4 1997Q3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<tbody>
<tr>
<td>C</td>
<td>0.001571</td>
<td>0.002842</td>
<td>0.552982</td>
<td>0.5867</td>
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<tr>
<td>PC1</td>
<td>0.024908</td>
<td>0.002337</td>
<td>10.65875</td>
<td>0.0000</td>
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<tr>
<td>PC2(-1)</td>
<td>-0.029753</td>
<td>0.008630</td>
<td>-3.447775</td>
<td>0.0027</td>
</tr>
<tr>
<td>PC4(-1)</td>
<td>-0.031440</td>
<td>0.014627</td>
<td>-2.149478</td>
<td>0.0447</td>
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<tr>
<td>DUMMYPC4(-1)</td>
<td>-0.017988</td>
<td>0.015598</td>
<td>-1.153205</td>
<td>0.2631</td>
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<tr>
<td>PC1(-2)</td>
<td>-0.018709</td>
<td>0.002522</td>
<td>-7.417825</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.703396</td>
<td>0.121062</td>
<td>-5.810187</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(4)</td>
<td>-0.491310</td>
<td>0.110327</td>
<td>-4.453206</td>
<td>0.0003</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.989896</td>
<td>0.054474</td>
<td>18.17188</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| R-squared       | 0.957769    | Mean dependent var | 0.000657
| Adjusted R-squared| 0.939987  | S.D. dependent var | 0.071338|
| S.E. of regression | 0.017476  | Akaike info criterion | -5.000873|
| Sum squared resid | 0.005803  | Schwarz criterion | -4.572664|
| Log likelihood   | 79.01222    | F-statistic      | 53.86292|
| Durbin-Watson stat | 2.205911  | Prob(F-statistic) | 0.000000|

| Inverted AR Roots | .45+.57i | .45-.57i | -.81+.53i | -.81-.53i |
| Inverted MA Roots | .71+.71i | .71+.71i | -.71-.71i | -.71-.71i |
9.2. Regression of real net taxes on products and imports on principal components
(no crisis dummy variables)

\[ DLTAXPROD = C(1) + C(2) \cdot PC1 + C(3) \cdot PC2(-1) + C(4) \cdot PC4(-1) + C(5) \cdot PC1(-2) + \]
\[ [AR(1)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1997Q4] \]

9.3. Regression of real net taxes on products and imports on Brent crude oil spot price

\[ DLTAXPROD = C(1) + C(2) \cdot DLBRENT + C(3) \cdot DLBRENT(-4) + \]
\[ [AR(1)=C(4),AR(4)=C(5),MA(2)=C(6),MA(4)=C(7),BACKCAST=1998Q2] \]

9.4. Regression of real net taxes on products and imports on crude oil production

\[ DLTAXPROD = C(1) + C(2) \cdot DLCRUDEOIL(-1) + C(3) \cdot DUMMYDLCRUDEOIL(-1) + \]
\[ C(4) \cdot DLCRUDEOIL(-3) + \]
\[ [AR(1)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q1] \]

9.5. Regression of real net taxes on products and imports on real M2

\[ DLTAXPROD = C(1) + C(2) \cdot DUMMYDLREALM2 + C(3) \cdot DLREALM2(-1) + \]
\[ C(4) \cdot DUMMYDLREALM2(-4) + \]
\[ [AR(2)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q2] \]

9.6. Regression of real net taxes on products and imports on real retail sales

\[ DLTAXPROD = C(1) + C(2) \cdot DLRETSALES + C(3) \cdot DLRETSALES(-1) + \]
\[ C(4) \cdot DLRETSALES(-4) + [AR(4)=C(5),MA(4)=C(6),BACKCAST=1998Q2] \]

9.7. Regression of real net taxes on products and imports on merchandise imports (in U.S. dollars)

\[ DLTAXPROD = C(1) + C(2) \cdot DLIMBOP + C(3) \cdot DLIMBOP(-1) + \]
\[ C(4) \cdot DUMMYDLIMBOP(-1) + C(5) \cdot DLIMBOP(-3) + \]
\[ [AR(1)=C(6),AR(2)=C(7),AR(3)=C(8),AR(4)=C(9),MA(4)=C(10), \]
\[ BACKCAST=1998Q1] \]

9.8. Regression of real net taxes on products and imports on car production

\[ DLTAXPROD = C(1) + C(2) \cdot DLCARS(-1) + C(3) \cdot DLCARS(-2) + C(4) \cdot DLCARS(-4) + \]
\[ [AR(1)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q2] \]
9.9. Regression of real net taxes on products and imports on principal components
(no contemporaneous independent variables)

\[ \text{DLTAXPROD} = C(1) + C(2)\ast \text{PC1}(-1) + C(3)\ast \text{PC2}(-1) + C(4)\ast \text{DUMMYP4}(-1) + C(5)\ast \text{PC1}(-2) + \{\text{AR(1)}=C(6), \text{AR(4)}=C(7), \text{MA(4)}=C(8), \text{BACKCAST}=1997Q4\} \]

9.10. Regression of real net taxes on products and imports on principal components
(no contemporaneous independent variables, no crisis dummy variables)

\[ \text{DLTAXPROD} = C(1) + C(2)\ast \text{PC1}(-1) + C(3)\ast \text{PC2}(-1) + C(4)\ast \text{PC4}(-1) + C(5)\ast \text{PC1}(-2) + \{\text{AR(1)}=C(6), \text{AR(4)}=C(7), \text{MA(4)}=C(8), \text{BACKCAST}=1997Q4\} \]

9.11. ARMA PC1 regression

\[ \text{PC1} = C(1) + C(2)\ast \text{DUMMY8} + C(3)\ast \text{DUMMY9} + C(4)\ast \text{PC1}(-1) + C(5)\ast \text{DUMMYP1}(-1) + C(6)\ast \text{PC1}(-2) + \{\text{MA(2)}=C(7), \text{MA(4)}=C(8), \text{BACKCAST}=1996Q4\} \]
Table 9.1. Net Indirect Tax Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5.15%</td>
<td>9.38%</td>
<td></td>
</tr>
<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>9.2.1.</td>
<td>Full</td>
<td>Yes</td>
<td>5.81%</td>
<td>9.10%</td>
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<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>9.2.2.</td>
<td>Full</td>
<td>No</td>
<td>6.41%</td>
<td>13.93%</td>
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<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>9.2.3.</td>
<td>Full</td>
<td>No</td>
<td>7.11%</td>
<td>7.87%</td>
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<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Crude oil production</td>
<td>9.2.4.</td>
<td>Full</td>
<td>Yes</td>
<td>8.67%</td>
<td>20.33%</td>
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<tr>
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<td>Forecast</td>
<td>Real M2</td>
<td>9.2.5.</td>
<td>Full</td>
<td>Yes</td>
<td>1.23%</td>
<td>3.91%</td>
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<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>9.2.6.</td>
<td>Full</td>
<td>No</td>
<td>6.02%</td>
<td>8.13%</td>
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<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>9.2.7.</td>
<td>Full</td>
<td>Yes</td>
<td>-0.89%</td>
<td>4.44%</td>
</tr>
<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Car production</td>
<td>9.2.8.</td>
<td>Full</td>
<td>No</td>
<td>0.40%</td>
<td>-1.78%</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------</td>
<td>----------------</td>
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<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>9.38%</td>
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<td>Forecast</td>
<td>PCs</td>
<td>9.2.9.</td>
<td>Full</td>
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<td>No</td>
<td>9.31%</td>
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<td>Forecast</td>
<td>PCs</td>
<td>9.2.10.</td>
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<td>No</td>
<td>9.81%</td>
</tr>
<tr>
<td>Real net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>9.2.1.</td>
<td>Full</td>
<td>Yes</td>
<td>Yes</td>
<td>8.56%</td>
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</table>
10. Household Consumption

10. Variables

The dependent variable: real household consumption, the difference of the logarithms of the year-over-year indices – DLHCONS

Special indicator: Real per capita consumer spending on goods and services, the difference of the logarithms of the year-over-year indices – DLREALPCCONS

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real retail sales
- Bread and bread product production (physical units)
- Car production (physical units)
- Crude oil production (physical units)
- Fabric production (physical units)
- Meat production (physical units)
- Milk production (physical units)
- Shoe production (physical units)
- Television set production (physical units)
- Employment
- Exports to CIS (in U.S. dollars)
- Imports from CIS (in U.S. dollars)
- Exports outside CIS (in U.S. dollars)
- Imports from outside CIS (in U.S. dollars)
- Real ruble/U.S. dollar exchange rate
- Real M2
- Real average wages
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer prices to freight transportation prices
- Ratio of consumer prices to construction prices
- Brent crude oil spot price (in $US)
Household Consumption Regressions

10.1. Regression of real household consumption on real per capita consumer spending on goods and services and principal components

\[ DLHCONS = C(1) + C(2) * DLREALPCCONS + C(3) * PC2 + C(4) * DUMMYPC2 + C(5) * PC1(-3) + \]
\[ AR(1)=C(6), AR(3)=C(7), AR(4)=C(8), MA(4)=C(9), BACKCAST=1998Q1 \]

Dependent Variable: DLHCONS
Method: Least Squares

Sample (adjusted): 1998Q1 2004Q3
Included observations: 27 after adjustments
Convergence achieved after 16 iterations
Backcast: 1997Q1 1997Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.004700</td>
<td>0.001955</td>
<td>2.404468</td>
<td>0.0272</td>
</tr>
<tr>
<td>DLREALPCCONS</td>
<td>0.271225</td>
<td>0.045445</td>
<td>5.968214</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.020395</td>
<td>0.014039</td>
<td>-1.452747</td>
<td>0.1635</td>
</tr>
<tr>
<td>DUMMYPC2</td>
<td>0.029825</td>
<td>0.014036</td>
<td>2.124885</td>
<td>0.0477</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>0.006648</td>
<td>0.001607</td>
<td>4.137680</td>
<td>0.0006</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.265787</td>
<td>0.073723</td>
<td>3.605220</td>
<td>0.0020</td>
</tr>
<tr>
<td>AR(3)</td>
<td>0.053622</td>
<td>0.042853</td>
<td>1.251282</td>
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</tr>
<tr>
<td>AR(4)</td>
<td>-0.516219</td>
<td>0.048905</td>
<td>-10.55551</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.987487</td>
<td>0.020007</td>
<td>49.35591</td>
<td>0.0000</td>
</tr>
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</table>

R-squared 0.979515  Mean dependent var 0.000929
Adjusted R-squared 0.970410  S.D. dependent var 0.039801
S.E. of regression 0.006846  Akaike info criterion -6.868984
Sum squared resid 0.000844  Schwarz criterion -6.437038
Log likelihood 101.7313  F-statistic 107.5841
Durbin-Watson stat 2.078189  Prob(F-statistic) 0.000000

Inverted AR Roots .67-.57i .67+.57i -.54+.61i -.54-.61i
Inverted MA Roots .70+.70i .70+.70i -.70-.70i -.70-.70i
10.2. Regression of real household consumption on real retail sales and principal components (real per capita consumer spending on goods and services is used as one of monthly indicators from which principal components are extracted)

\[ DLHCONS = C(1) + C(2) \cdot DLRETSALES + C(3) \cdot PC2 + C(4) \cdot DUMMYPC2 + C(5) \cdot PC1(-3) + \]
\[ [AR(1)=C(6), AR(3)=C(7), AR(4)=C(8), MA(4)=C(9), BACKCAST=1998Q1] \]

10.3. Regression of real household consumption on real per capita consumer spending on goods and services and principal components (no crisis dummies)

\[ DLHCONS = C(1) + C(2) \cdot DLREALPCCONS + C(3) \cdot PC2 + C(4) \cdot PC1(-3) + \]
\[ [AR(1)=C(5), AR(3)=C(6), AR(4)=C(7), MA(4)=C(8), BACKCAST=1998Q1] \]

10.4. Regression of real household consumption on real per capita consumer spending on goods and services

\[ DLHCONS = C(1) + C(2) \cdot DLREALPCCONS + \]

10.5. Regression of real household consumption on Brent crude oil spot price

\[ DLHCONS = C(1) + C(2) \cdot DLBRENT(-1) + C(3) \cdot DLBRENT(-2) + C(4) \cdot DLBRENT(-3) + \]
\[ [AR(3)=C(5), AR(4)=C(6), MA(4)=C(7), BACKCAST=1998Q1] \]

10.6. Regression of real household consumption on real retail sales

\[ DLHCONS = C(1) + C(2) \cdot DLRETSALES + C(3) \cdot DLRETSALES(-4) + \]

10.7. Regression of real household consumption on real M2

\[ DLHCONS = C(1) + C(2) \cdot DLREALM2 + \]

10.8. Regression of real household consumption on real average wages

\[ DLHCONS = C(1) + C(2) \cdot DLREALWAGE + \]

10.9. Regression of real household consumption on principal components (no contemporaneous variables, no crisis dummies)

\[ DLHCONS = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot PC1(-2) + \]
10.10. Regression of real household consumption on principal components (no contemporaneous variables)

\[ DLHCONS = C(1) + C(2)*PC1(-1) + C(3)*PC1(-2) + C(4)*DUMMYPC1(-2) + \]
\[ [AR(3)=C(5), AR(4)=C(6), MA(4)=C(7), BACKCAST=1997Q4] \]

10.11. ARMA regression of real per capita consumer spending on goods and services

\[ DLREALPCCONS = C(1) + C(2)*DUMMY3 + C(3)*DLREALPCCONS(-4) + \]

10.12. ARMA PC2 regression

\[ PC2 = C(1) + C(2)*PC2(-4) + C(3)*DUMMYPC2(-4) + \]
\[ [MA(3)=C(4), MA(4)=C(5), BACKCAST=1997Q2] \]
Table 10.1. Household Consumption Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real household consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.80%</td>
<td>12.08%</td>
</tr>
<tr>
<td>Real per capita consumer spending on goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.02%</td>
<td>12.71%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real per capita consumer spending and principal components</td>
<td>10.1</td>
<td>Full</td>
<td>Yes</td>
<td>10.91%</td>
<td>12.00%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real retail sales and principal components</td>
<td>10.2</td>
<td>Full</td>
<td>Yes</td>
<td>11.03%</td>
<td>12.40%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real per capita consumer spending and principal components</td>
<td>10.3</td>
<td>Full</td>
<td>No</td>
<td>11.07%</td>
<td>12.31%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real per capita consumer spending</td>
<td>10.4</td>
<td>Full</td>
<td>No</td>
<td>10.76%</td>
<td>12.47%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>10.5</td>
<td>Full</td>
<td>No</td>
<td>10.69%</td>
<td>13.68%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>10.6</td>
<td>Full</td>
<td>No</td>
<td>11.06%</td>
<td>12.59%</td>
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<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real M2</td>
<td>10.7</td>
<td>Full</td>
<td>No</td>
<td>8.80%</td>
<td>8.39%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real average wages</td>
<td>10.8</td>
<td>Full</td>
<td>No</td>
<td>9.15%</td>
<td>9.10%</td>
</tr>
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</table>
Table 10.2. Household Consumption Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real household consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.08%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real per capita consumer spending and principal components</td>
<td>10.9</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>11.68%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real per capita consumer spending and principal components</td>
<td>10.10</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>11.65%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real per capita consumer spending and principal components</td>
<td>10.1</td>
<td>Full</td>
<td>Yes</td>
<td>Yes</td>
<td>11.60%</td>
</tr>
</tbody>
</table>
11. Government Consumption

Variables

The dependent variable: real government consumption, the difference of the logarithms of the year-over-year indices – DLGOV

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real retail sales
- Real inventories in retail sales
- Freight transportation (in tons-kilometers)
- Car production (in physical units)
- Crude oil production (in physical units)
- Electricity production (in physical units)
- Natural gas production (in physical units)
- Steel production (in physical units)
- Exports to CIS (in U.S. dollars)
- Exports outside CIS (in U.S. dollars)
- Imports from CIS (in U.S. dollars)
- Imports from outside CIS (in U.S. dollars)
- Employment
- Unemployment rate
- Real average wages
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of consolidated budget expenditures to consolidated budget revenues
- Ratio of defense expenditures to consolidated budget expenditures
- Ratio of consumer prices to industrial producer prices
- Brent crude oil spot price (in U.S. dollars)
Government Consumption Regressions

11.1. Regression of real government consumption on principal components

\[ DLGOV = C(1) + C(2)\times DUMMYDLGOV(-4) + C(3)\times PC1 + C(4)\times PC2 + C(5)\times PC4 + C(6)\times PC1(-4) + [AR(4)=C(7), MA(4)=C(8), BACKCAST=1998Q2] \]

Dependent Variable: DLGOV
Method: Least Squares

Sample (adjusted): 1998Q2 2004Q3
Included observations: 26 after adjustments
Convergence achieved after 11 iterations
Backcast: 1997Q2 1998Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.000280</td>
<td>0.001320</td>
<td>-0.211817</td>
<td>0.8346</td>
</tr>
<tr>
<td>DUMMYDLGOV(-4)</td>
<td>-0.278520</td>
<td>0.150844</td>
<td>-1.846411</td>
<td>0.0813</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.004307</td>
<td>0.001968</td>
<td>-2.188399</td>
<td>0.0421</td>
</tr>
<tr>
<td>PC2</td>
<td>0.007453</td>
<td>0.004924</td>
<td>1.513703</td>
<td>0.1475</td>
</tr>
<tr>
<td>PC4</td>
<td>-0.014693</td>
<td>0.004934</td>
<td>-2.978096</td>
<td>0.0081</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>-0.003786</td>
<td>0.001768</td>
<td>-2.141236</td>
<td>0.0462</td>
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<tr>
<td>AR(4)</td>
<td>0.427651</td>
<td>0.121348</td>
<td>3.524155</td>
<td>0.0024</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.989979</td>
<td>0.051131</td>
<td>-19.36168</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.842159  Mean dependent var 0.000224
Adjusted R-squared 0.780776  S.D. dependent var 0.022227
S.E. of regression 0.010407  Akaike info criterion -6.045002
Sum squared resid 0.000000  Schwarz criterion -5.657895
Log likelihood 86.58502  F-statistic 13.71979
Durbin-Watson stat 1.973545  Prob(F-statistic) 0.000005

Inverted AR Roots .81  .00-.81i
Inverted MA Roots 1.00  .00+1.00i  .00-1.00i  -1.00
11.2. Regression of real government consumption on principal components (no crisis dummies)

\[ DLGOV = C(1) + C(2) \times DLGOV(-4) + C(3) \times PC1 + C(4) \times PC2 + C(5) \times PC4 + \\
C(6) \times PC1(-4) + [AR(4)=C(7), MA(4)=C(8), BACKCAST=1999Q2] \]

11.3. Regression of real government consumption on Brent crude oil spot price (post-crisis sample)

\[ DLGOV = C(1) + C(2) \times DLGOV(-2) + C(3) \times DLGOV(-4) + C(4) \times DLBRENT + \\
[MA(4)=C(5), BACKCAST=1999Q4] \]

11.4. Regression of real government consumption on the ratio of consolidated government budget expenditures to revenues (post-crisis sample)

\[ DLGOV = C(1) + C(2) \times DLGOV(-4) + C(3) \times DLCONSEXPREV(-1) + \\
[MA(4)=C(4), BACKCAST=1999Q4] \]

11.5. Regression of real government consumption on real M2

\[ DLGOV = C(1) + C(2) \times DLGOV(-4) + C(3) \times DLREALM2(-1) + \\
[AR(1)=C(4), AR(4)=C(5), MA(4)=C(6), BACKCAST=1999Q2] \]

11.6. Regression of real government consumption on crude oil production

\[ DLGOV = C(1) + C(2) \times DUMMYDLCRDEOIL(-1) + C(3) \times DLCRDEOIL(-3) + \\
C(4) \times DUMMYDLCRDEOIL(-3) + [AR(4)=C(5), MA(4)=C(6), BACKCAST=1999Q1] \]

11.7. Regression of real government consumption on employment

\[ DLGOV = C(1) + C(2) \times DLGOV(-4) + C(3) \times DUMMYDLGOV(-4) + C(4) \times DLEMPL(-1) + \\
C(5) \times DUMMYDLEMPL(-1) + [AR(4)=C(6), MA(4)=C(7), BACKCAST=1999Q2] \]

11.8. Regression of real government consumption on merchandise exports to CIS

\[ DLGOV = C(1) + C(2) \times DUMMYDLGOV(-4) + C(3) \times DLEXPCIS(-1) + \\

11.9. Regression of real government consumption on principal components (no contemporaneous variables)

\[ DLGOV = C(1) + C(2) \times DUMMYDLGOV(-4) + C(3) \times PC1(-1) + C(4) \times PC1(-2) + \\
C(5) \times PC1(-3) + [AR(4)=C(6), MA(4)=C(7), BACKCAST=1999Q2] \]
11.10. Regression of real government consumption on principal components (no contemporaneous variables, no crisis dummies)

\[
DLGOV = C(1) + C(2)*DLGOV(-4) + C(3)*PC1(-1) + C(4)*PC1(-2) + C(5)*PC1(-3) + \]
\[
[AR(4)=C(6),MA(4)=C(7),BACKCAST=1998Q2]
\]

11.11. Regression of real government consumption on principal components (no contemporaneous variables, post-crisis sample)

\[
DLGOV = C(1) + C(2)*DLGOV(-4) + C(3)*PC1(-2) + C(4)*PC1(-3) + \]
\[
[AR(3)=C(5),MA(4)=C(6),BACKCAST=2000Q3]
\]

11.12. ARMA PC1 regression

\[
PC1 = C(1) + C(2)*DUMMY8 + C(3)*DUMMY9 + C(4)*DUMMYPC1(-1) + \]
\[
[MA(4)=C(5),BACKCAST=1996Q3]
\]

11.13. ARMA PC2 regression (post-crisis sample)

\[
PC2 = C(1) + C(2)*PC2(-1) + C(3)*PC2(-2) + [MA(4)=C(4),BACKCAST=1999Q2]
\]

11.14. ARMA PC4 regression

\[
PC4 = C(1) + C(2)*PC4(-1) + [MA(4)=C(3),BACKCAST=1996Q3]
\]
Table 11.1. Government Consumption Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real government consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2.40%</td>
<td>2.62%</td>
<td></td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PC's</td>
<td>11.1</td>
<td>Full</td>
<td>Yes</td>
<td>2.52%</td>
<td>2.69%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PC's</td>
<td>11.2</td>
<td>Full</td>
<td>No</td>
<td>2.52%</td>
<td>2.53%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>11.3</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>3.07%</td>
<td>3.61%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Ratio of consolidated government budget expenditures to revenues</td>
<td>11.4</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>1.27%</td>
<td>0.96%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real M2</td>
<td>11.5</td>
<td>Full</td>
<td>No</td>
<td>1.54%</td>
<td>1.79%</td>
</tr>
<tr>
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<td>Forecast</td>
<td>Crude oil production</td>
<td>11.6</td>
<td>Full</td>
<td>Yes</td>
<td>1.71%</td>
<td>1.98%</td>
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<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Employment</td>
<td>11.7</td>
<td>Full</td>
<td>Yes</td>
<td>1.50%</td>
<td>1.68%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Merchandise exports to CIS countries</td>
<td>11.8</td>
<td>Full</td>
<td>Yes</td>
<td>2.21%</td>
<td>2.32%</td>
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</table>
Table 11.2. Government Consumption Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real government consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2.62%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PC's</td>
<td>11.9</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>2.43%</td>
</tr>
<tr>
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<td>Forecast</td>
<td>PC's</td>
<td>11.10</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>2.39%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PC's</td>
<td>11.11</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>No</td>
<td>2.26%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PC's</td>
<td>11.1</td>
<td>Full*</td>
<td>Yes</td>
<td>Yes</td>
<td>2.76%</td>
</tr>
</tbody>
</table>

Note:  PC2 is forecasted using the post-crisis sample
12. Non-Commercial Organizations Serving Households

Variables

The dependent variable: real consumption by non-commercial organizations serving households, the difference of the logarithms of the year-over-year indices – DLNCO

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real industrial production
- Real retail sales
- Real inventories in retail trade
- Freight transportation (in tons/kilometers)
- Real per capita consumer spending on goods and services
- Merchandise exports to CIS countries (in U.S. dollars)
- Merchandise exports to non-CIS countries (in U.S. dollars)
- Merchandise imports from CIS countries (in U.S. dollars)
- Merchandise imports from non-CIS countries (in U.S. dollars)
- Employment
- Real average wages
- Real ruble/U.S. dollar exchange rate
- Ratio of consolidated budget expenditures to consolidated budget revenues
- Ratio of defense expenditures to consolidated budget expenditures
- Real M2
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer services prices to consumer prices
- Brent crude oil spot price (in U.S. dollars)
12.1. Regression of real consumption by non-commercial organizations serving households on principal components

\[ DLNCO = C(1) + C(2)*DLNCO(-1) + C(3)*PC1 + C(4)*DUMMYPC1 + C(5)*PC2 + C(6)*DUMMYPC3 + C(7)*PC1(-3) + [AR(1)=C(8),AR(2)=C(9),MA(4)=C(10),BACKCAST=1997Q3] \]

Dependent Variable: DLNCO
Method: Least Squares

Sample (adjusted): 1997Q3 2004Q3
Included observations: 29 after adjustments
Convergence achieved after 14 iterations
Backcast: 1996Q3 1997Q2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.004920</td>
<td>0.001960</td>
<td>-2.509822</td>
<td>0.0213</td>
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<tr>
<td>DLNCO(-1)</td>
<td>-0.730791</td>
<td>0.228588</td>
<td>-3.196984</td>
<td>0.0047</td>
</tr>
<tr>
<td>PC1</td>
<td>0.004243</td>
<td>0.001970</td>
<td>2.154008</td>
<td>0.0443</td>
</tr>
<tr>
<td>DUMMYPC1</td>
<td>-0.011373</td>
<td>0.003231</td>
<td>-3.520433</td>
<td>0.0023</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.031547</td>
<td>0.004646</td>
<td>-6.790813</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMYPC3</td>
<td>-0.016526</td>
<td>0.003853</td>
<td>-4.289100</td>
<td>0.0004</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>0.003089</td>
<td>0.000666</td>
<td>4.641088</td>
<td>0.0002</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-1.151752</td>
<td>0.165501</td>
<td>-6.959168</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.644318</td>
<td>0.137546</td>
<td>-4.684368</td>
<td>0.0002</td>
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<tr>
<td>MA(4)</td>
<td>0.989968</td>
<td>0.120746</td>
<td>8.198729</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.910313  Mean dependent var -0.000676
Adjusted R-squared 0.867830  S.D. dependent var 0.037972
S.E. of regression 0.013805  Akaike info criterion -5.460797
Sum squared resid 0.003621  Schwarz criterion -4.989316
Log likelihood 89.18156  F-statistic 21.42752
Durbin-Watson stat 1.999148  Prob(F-statistic) 0.000000

Inverted AR Roots -.58+.56i -.58-.56i
Inverted MA Roots .71+.71i .71+.71i -.71-.71i -.71-.71i
12.2. Regression of real consumption by non-commercial organizations serving households on principal components (no crisis dummies)

\[
DLNCO = C(1) + C(2)*DLNCO(-1) + C(3)*PC2 + C(4)*PC3 + C(5)*PC1(-3) + \\
\quad [AR(1)=C(6),AR(2)=C(7),MA(4)=C(8),BACKCAST=1997Q3]
\]

12.3. Regression of real consumption by non-commercial organizations serving households on Brent crude oil spot price

\[
DLNCO = C(1) + C(2)*DUMMY2 + C(3)*DLNCO(-2) + C(4)*DLBRENT + \\
\quad C(5)*DUMMYDLBRENT + C(6)*DLBRENT(-4) + C(7)*DUMMYDLBRENT(-4) + \\
\quad [AR(1)=C(8),AR(3)=C(9)]
\]

12.4. Regression of real consumption by non-commercial organizations serving households on real M2

\[
DLNCO = C(1) + C(2)*DLNCO(-1) + C(3)*DLNCO(-2) + C(4)*DLREALM2(-1) + \\
\quad C(5)*DLREALM2(-2) + C(6)*DLREALM2(-4) + \\
\quad [AR(1)=C(7),AR(4)=C(8),MA(4)=C(9),BACKCAST=1998Q2]
\]

12.5. Regression of real consumption by non-commercial organizations serving households on real industrial production

\[
DLNCO = C(1) + C(2)*DLNCO(-1) + C(3)*DLIND + C(4)*DUMMYDLIND + \\
\quad C(5)*DLIND(-2) + C(6)*DUMMYDLIND(-2) + \\
\quad [AR(3)=C(7),MA(4)=C(8),BACKCAST=1997Q3]
\]

12.6. Regression of real consumption by non-commercial organizations serving households on real average wage

\[
DLNCO = C(1) + C(2)*DLNCO(-1) + C(3)*DLNCO(-2) + C(4)*DLREALWAGE(-1) + \\
\quad [AR(1)=C(5),AR(2)=C(6),AR(3)=C(7),MA(4)=C(8),BACKCAST=1997Q3]
\]

12.7. Regression of real consumption by non-commercial organizations serving households on employment

\[
DLNCO = C(1) + C(2)*DLNCO(-1) + C(3)*DLNCO(-2) + C(4)*DLEMP + \\
\quad C(5)*DLEMP(-3) + C(6)*DLEMP(-4) + \\
\quad [AR(2)=C(7),AR(3)=C(8),MA(4)=C(9),BACKCAST=1998Q1]
\]

12.8. Regression of real consumption by non-commercial organizations serving households on freight transportation in tons-kilometers

\[
DLNCO = C(1) + C(2)*DUMMYDLNCO(-1) + C(3)*DLNCO(-2) + \\
\quad C(4)*DLTRANSPORT + C(5)*DLTRANSPORT(-2) + \\
\quad [AR(4)=C(6),MA(4)=C(7),BACKCAST=1997Q4]
\]
12.9. Regression of real consumption by non-commercial organizations serving households on principal components (no contemporaneous independent variables)

\[ DLNCO = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot PC1(-2) + C(4) \cdot DUMMYPC1(-2) + C(5) \cdot PC1(-3) + C(6) \cdot DUMMYPC1(-3) + [AR(4)=C(7),MA(4)=C(8),BACKCAST=1998:1] \]

12.10. Regression of real consumption by non-commercial organizations serving households on principal components (no contemporaneous independent variables, no crisis dummies)

\[ DLNCO = C(1) + C(2) \cdot PC1(-2) + C(3) \cdot PC1(-3) + [AR(4)=C(4),MA(4)=C(5),BACKCAST=1998:1] \]

12.11. ARMA PC1 regression (post-crisis sample)

\[ PC1 = C(1) + C(2) \cdot DUMMY9 + C(3) \cdot PC1(-2) + [AR(1)=C(4),MA(4)=C(5),BACKCAST=1999:3] \]

12.12. ARMA PC2 regression

\[ PC2 = C(1) + C(2) \cdot PC2(-2) + C(3) \cdot DUMMYPC2(-2) + C(4) \cdot PC2(-4) + [AR(1)=C(5),AR(4)=C(6),MA(2)=C(7),MA(4)=C(8),BACKCAST=1998:2] \]

12.13. ARMA PC3 regression

\[ PC3 = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot PC3(-1) + C(4) \cdot PC3(-4) + C(5) \cdot DUMMYPC3(-4) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997:3] \]
Table 12.1. Growth Rates of Consumption by Non-Commercial Organizations Serving Households. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.00%</td>
<td>-1.94%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>PC's</td>
<td>12.1</td>
<td>Full</td>
<td>Yes</td>
<td>0.13%</td>
<td>-0.58%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>PC's</td>
<td>12.2</td>
<td>Full</td>
<td>No</td>
<td>1.47%</td>
<td>-0.36%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>12.3</td>
<td>Full</td>
<td>Yes</td>
<td>1.92%</td>
<td>1.63%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>Real M2</td>
<td>12.4</td>
<td>Full</td>
<td>No</td>
<td>2.07%</td>
<td>-0.22%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>12.5</td>
<td>Full</td>
<td>Yes</td>
<td>2.23%</td>
<td>0.66%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>Real average wage</td>
<td>12.6</td>
<td>Full</td>
<td>No</td>
<td>1.24%</td>
<td>1.11%</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------</td>
<td>------------------</td>
<td>------</td>
<td>------</td>
<td>----</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>Employment</td>
<td>12.7</td>
<td>Full</td>
<td>No</td>
<td>2.47%</td>
<td>-0.39%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>Freight transportation</td>
<td>12.8</td>
<td>Full</td>
<td>Yes</td>
<td>2.06%</td>
<td>4.09%</td>
</tr>
</tbody>
</table>
Table 12.2. Growth Rates of Consumption by Non-Commercial Organizations Serving Households. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-1.94%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations serving households</td>
<td>Forecast</td>
<td>PC's</td>
<td>12.9</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>-2.23%</td>
</tr>
<tr>
<td></td>
<td>Forecast</td>
<td>PC's</td>
<td>12.10</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>-0.14%</td>
</tr>
<tr>
<td></td>
<td>Forecast</td>
<td>PC's</td>
<td>12.1</td>
<td>Full*</td>
<td>Yes</td>
<td>Yes</td>
<td>-0.88%</td>
</tr>
</tbody>
</table>

Note: * PC1 is forecasted on the basis of the post-crisis sample
13. Fixed Investment

Variables

The dependent variable: real gross fixed investment, the difference of the logarithms of the year-over-year indices – DLINVNA

The special variable: real gross fixed investment (“monthly” methodology), the difference of the logarithms of the year-over-year indices – DLFIXEDINV

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real industrial production
- Real retail sales
- Real construction
- Freight transportation (in ton-kilometers)
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of consolidated government budget expenditures to revenues
- Ratio of consumer prices to construction prices
- Ratio of freight transportation prices to construction prices
- Ratio of construction prices to freight transportation prices
- Brent crude oil spot price (in U.S. dollars)
Fixed Investment Regressions

13.1. Regression of real fixed investment (national accounts) on real fixed investment ("monthly" methodology) and a principal component

\[
DLINVNA = C(1) + C(2) \times DLFIXEDINV + C(3) \times PC2 + 
[AR(1)=C(4),AR(2)=C(5),MA(3)=C(6),BACKCAST=1998:3]
\]

Dependent Variable: DLINVNA
Method: Least Squares

Sample(adjusted): 1998:3 2004:3
Included observations: 25 after adjusting endpoints
Convergence achieved after 15 iterations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.000429</td>
<td>0.000541</td>
<td>-0.792358</td>
<td>0.4379</td>
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<tr>
<td>DLFIXEDINV</td>
<td>1.000732</td>
<td>0.050592</td>
<td>19.78039</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>0.003335</td>
<td>0.003080</td>
<td>1.082619</td>
<td>0.2925</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.515407</td>
<td>0.125841</td>
<td>-4.095698</td>
<td>0.0006</td>
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<tr>
<td>AR(2)</td>
<td>-0.720880</td>
<td>0.114674</td>
<td>-6.286317</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(3)</td>
<td>-0.992150</td>
<td>0.019222</td>
<td>-51.61570</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.964282  Mean dependent var 0.006428
Adjusted R-squared 0.964882  S.D. dependent var 0.070475
S.E. of regression 0.014970  Akaike info criterion -5.360031
Sum squared resid 0.014258  Schwarz criterion -5.067501
Log likelihood 73.00038  F-statistic 102.5887
Durbin-Watson stat 2.361745  Prob(F-statistic) 0.000000

Inverted AR Roots -.26+.81i -.26-.81i
Inverted MA Roots 1.00 -.50+.86i -.50-.86i
13.2. Regression of real fixed investment (national accounts) on real fixed investment ("monthly" methodology)

\[ DLINVNA = C(1) + C(2) * DLFIXEDINV + \]

13.3. Regression of real fixed investment (national accounts) on Brent crude oil spot price

\[ DLINVNA = C(1) + C(2) * DLBRENT(-1) + \]

13.4. Regression of real fixed investment (national accounts) on real industrial production

\[ DLINVNA = C(1) + C(2) * DLINVNA(-1) + C(3) * DLIND + \]

13.5. Regression of real fixed investment (national accounts) on real construction

\[ DLINVNA = C(1) + C(2) * DLCONSTR + C(3) * DLCONSTR(-1) + \]
\[ [AR(1)=C(4), AR(2)=C(5), MA(3)=C(6), BACKCAST=1998Q4] \]

13.6. Regression of real fixed investment (national accounts) on real M2

\[ DLINVNA = C(1) + C(2) * DLINVNA(-1) + C(3) * DLREALM2 + \]

13.7. Regression of real fixed investment (national accounts) on a principal component (no contemporaneous independent variables)

\[ DLINVNA = C(1) + C(2) * DLINVNA(-1) + C(3) * PC1(-1) + \]

13.8. ARMA regression of real fixed investment ("monthly" methodology)

\[ DLFIXEDINV = C(1) + C(2) * DLFIXEDINV(-1) + C(3) * DLFIXEDINV(-2) + \]

13.9. ARMA PC2 regression

\[ PC2 = C(1) + C(2) * PC2(-1) + C(3) * PC2(-4) + [MA(4)=C(4), BACKCAST=1999Q1] \]
Table 13.1. Fixed Investment Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real fixed investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.67%</td>
<td>10.37%</td>
<td></td>
</tr>
<tr>
<td>Real fixed investment (<em>monthly</em> methodology)</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.30%</td>
<td>10.40%</td>
<td></td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Real fixed investment (<em>monthly</em> methodology) and PCs</td>
<td>13.1</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>11.93%</td>
<td>10.39%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Real fixed investment (<em>monthly</em> methodology)</td>
<td>13.2</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>11.45%</td>
<td>9.62%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>13.3</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>10.90%</td>
<td>17.52%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>13.4</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>16.60%</td>
<td>17.67%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Real construction</td>
<td>13.5</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>12.82%</td>
<td>9.09%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Real M2</td>
<td>13.6</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>7.60%</td>
<td>4.57%</td>
</tr>
</tbody>
</table>
Table 13.2. Fixed Investment Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real fixed investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.37%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>PCs</td>
<td>13.7</td>
<td>First quarter 1998 - third quarter 2004</td>
<td>No</td>
<td>No</td>
<td>10.68%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Forecast</td>
<td>Real fixed investment (&quot;monthly&quot; methodology) and PCs</td>
<td>13.1</td>
<td>First quarter 1998 - third quarter 2006</td>
<td>No</td>
<td>Yes</td>
<td>11.38%</td>
</tr>
</tbody>
</table>
14. Investment Ratio

Variables

The dependent variable: ratio of the real total investment to real fixed investment year-over-year indices, the difference of logarithms – DLINVRATIO

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real industrial production
- Real retail sales
- Real fixed investment
- Freight transportation (in ton-kilometers)
- Merchandise exports to CIS (in U.S. dollars)
- Merchandise exports outside CIS (in U.S. dollars)
- Merchandise imports from CIS (in U.S. dollars)
- Merchandise imports from outside CIS (in U.S. dollars)
- Real ruble/U.S. dollar exchange rate
- Real M2
- Real per capita consumer spending on goods and services
- Ratio of consolidated government budget expenditures to revenues
- Ratio of consumer prices to construction prices
- Ratio of freight transportation prices to construction prices
- Ratio of consumer prices to industrial producer prices
- Brent crude oil spot price
14.1. Regression of the real investment ratio on principal components

\[ DLINVRATIO = C(1) + C(2) \times PC1 + C(3) \times PC2 + C(4) \times PC4 + \]
\[ [AR(1)=C(5),MA(4)=C(6),BACKCAST=2000:1] \]

Dependent Variable: DLINVRATIO
Method: Least Squares
Sample: 2000:1 2004:3
Included observations: 19
Convergence achieved after 11 iterations
Backcast: 1999:1 1999:4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.028239</td>
<td>0.006395</td>
<td>-4.415757</td>
<td>0.0007</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.186714</td>
<td>0.045024</td>
<td>-4.146971</td>
<td>0.0011</td>
</tr>
<tr>
<td>PC2</td>
<td>0.074701</td>
<td>0.052018</td>
<td>1.436046</td>
<td>0.1746</td>
</tr>
<tr>
<td>PC4</td>
<td>0.160634</td>
<td>0.055045</td>
<td>2.918241</td>
<td>0.0120</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.424111</td>
<td>0.082785</td>
<td>-5.123057</td>
<td>0.0002</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.980469</td>
<td>0.011743</td>
<td>-83.49379</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.967075 Mean dependent var -0.056363
Adjusted R-squared 0.954411 S.D. dependent var 0.210066
S.E. of regression 0.044852 Akaike info criterion -3.118787
Sum squared resid 0.026153 Schwarz criterion -2.820543
Log likelihood 35.62848 F-statistic 76.36636
Durbin-Watson stat 2.267889 Prob(F-statistic) 0.000000
Inverted AR Roots -.42
Inverted MA Roots 1.00 .00+1.00i -.00 -1.00i -1.00
14.2. Regression of the real investment ratio on Brent crude oil spot price

\[ DLINV/RATIO = C(1) + C(2) \times DLBRENT + \]
\[ [AR(1)=C(3), MA(4)=C(4), BACKCAST=2000:1] \]

14.3. Regression of the real investment ratio on the real ruble/U.S. dollar exchange rate

\[ DLINV/RATIO = C(1) + C(2) \times DLREALEXRATE(-2) + C(3) \times DLREALEXRATE(-4) + \]
\[ [AR(1)=C(4), MA(4)=C(5), BACKCAST=1997:3] \]

14.4. Regression of the real investment ratio on real industrial production

\[ DLINV/RATIO = C(1) + C(2) \times DLIND + C(3) \times DLIND(-1) + \]
\[ [AR(1)=C(4), AR(2)=C(5), MA(4)=C(6), BACKCAST=2000Q1] \]

14.5. Regression of the real investment ratio on real retail sales

\[ DLINV/RATIO = C(1) + C(2) \times DLRETAILSALES(-2) + C(3) \times DLRETAILSALES(-4) + \]
\[ [AR(1)=C(4), MA(4)=C(5), BACKCAST=2000Q1] \]

14.6. Regression of the real investment ratio on freight transportation

\[ DLINV/RATIO = C(1) + C(2) \times DLTRANSPORT + \]
\[ [AR(1)=C(3), MA(4)=C(4), BACKCAST=2000Q1] \]

14.7. Regression of the real investment ratio on real per capita consumer spending on goods and services

\[ DLINV/RATIO = C(1) + C(2) \times DLREALPCCONS(-2) + C(3) \times DLREALPCCONS(-4) + \]
\[ [AR(1)=C(4), MA(4)=C(5), BACKCAST=2000:1] \]

14.8. Regression of the real investment ratio on principal components (no contemporaneous independent variables)

\[ DLINV/RATIO = C(1) + C(2) \times PC1(-1) + C(3) \times PC6(-1) + \]
\[ [AR(1)=C(4), MA(4)=C(5), BACKCAST=2000Q1] \]

14.9. ARMA PC1 regression (full-sample)

\[ PC1 = C(1) + C(2) \times DUMMY8 + C(3) \times DUMMY9 + C(4) \times PC1(-1) + \]
\[ [MA(4)=C(5), BACKCAST=1996Q3] \]

14.10. ARMA PC2 regression (post-crisis sample)

\[ PC2 = C(1) + C(2) \times PC2(-1) + C(3) \times PC2(-4) + [MA(5)=C(4), BACKCAST=1999:4] \]
14.11. ARMA PC4 regression (post-crisis sample)

\[ PC4 = C(1) + C(2) \times PC4(-2) + [MA(5)=C(3),BACKCAST=1999:2] \]
### Table 14.1. Change in Investment Ratio. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real investment ratio</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.67%</td>
<td>2.65%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>PCs</td>
<td>14.1</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>5.27%</td>
<td>2.97%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>14.2</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>21.50%</td>
<td>15.70%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>Real ruble/dollar exchange rate</td>
<td>14.3</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>-1.63%</td>
<td>-4.54%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>14.4</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>3.12%</td>
<td>7.57%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>14.5</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>3.38%</td>
<td>6.51%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>Freight transportation</td>
<td>14.6</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>-0.34%</td>
<td>-11.89%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>Real consumer spending on goods and services</td>
<td>14.7</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>11.06%</td>
<td>7.69%</td>
</tr>
</tbody>
</table>
Table 14.2. Change in Investment Ratio. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Real investment ratio</th>
<th>Official</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
<th>N/A</th>
<th>2.65%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>PCs</td>
<td>14.8</td>
<td>First quarter 2000 - third quarter 2004</td>
<td>N/A</td>
<td>No</td>
<td>2.36%</td>
</tr>
<tr>
<td>Real investment ratio</td>
<td>Forecast</td>
<td>PCs</td>
<td>14.1</td>
<td>First quarter 2000 - third quarter 2004*</td>
<td>N/A</td>
<td>Yes</td>
<td>1.64%</td>
</tr>
</tbody>
</table>

Note: * PC1 estimated on the basis of the full sample; PC2 and PC4 estimated on the basis of the post-crisis sample
15. Exports

Variables

The **dependent variable**: real exports of goods and services, the difference of the logarithms of the year-over-year indices – DLEXPGS

**Special indicator**: merchandise exports (in U.S. dollars), the difference of the logarithms of the year-over-year indices – DLEXPORTS

**The set of monthly indicators used in the extraction of the principal components (PC’s):**

- Real agricultural production
- Real construction
- Real retail sales
- Freight transportation (in tons-kilometers)
- Car production (in physical units)
- Coal production (in physical units)
- Crude oil production (in physical units)
- Natural gas production (in physical units)
- Mineral fertilizer production (in physical units)
- Steel production (in physical units)
- Wood production (in physical units)
- Merchandise imports to CIS (in U.S. dollar)
- Merchandise imports outside CIS (in U.S. dollars)
- Employment
- Real average wage
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer prices to freight transportation prices
- Brent crude oil spot price (in U.S. dollars)
Real Exports Regressions

15.1. Regression of real exports of goods and services on merchandise exports (in U.S. dollars) and principal components

\[ DLEXPGS = C(1) + C(2)\times DLEXPORTS + C(3)\times DLEXPORTS(-1) + C(4)\times PC1 + C(5)\times PC8 + C(6)\times PC1(-2) + C(7)\times PC10(-3) + [AR(1)=C(8),AR(2)=C(9),AR(3)=C(10),AR(4)=C(11),MA(2)=C(12),MA(4)=C(13),BACKCAST=1998Q1] \]

Dependent Variable: DLEXPGS
Method: Least Squares

Sample (adjusted): 1998Q1 2004Q3
Included observations: 27 after adjustments
Failure to improve SSR after 17 iterations
Backcast: 1997Q1 1997Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.003716</td>
<td>0.001245</td>
<td>2.984100</td>
<td>0.0099</td>
</tr>
<tr>
<td>DLEXPORTS</td>
<td>0.341647</td>
<td>0.037927</td>
<td>9.008117</td>
<td>0.0000</td>
</tr>
<tr>
<td>DLEXPORTS(-1)</td>
<td>-0.188488</td>
<td>0.029074</td>
<td>-6.482931</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.010455</td>
<td>0.001640</td>
<td>-6.372959</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC8</td>
<td>-0.023664</td>
<td>0.016856</td>
<td>-1.403894</td>
<td>0.1821</td>
</tr>
<tr>
<td>PC1(-2)</td>
<td>-0.001650</td>
<td>0.001331</td>
<td>-1.239420</td>
<td>0.2356</td>
</tr>
<tr>
<td>PC10(-3)</td>
<td>0.021233</td>
<td>0.009107</td>
<td>2.331569</td>
<td>0.0352</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-1.114105</td>
<td>0.217891</td>
<td>-5.113121</td>
<td>0.0002</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.787985</td>
<td>0.307440</td>
<td>-2.563053</td>
<td>0.0225</td>
</tr>
<tr>
<td>AR(3)</td>
<td>-0.749752</td>
<td>0.290252</td>
<td>-2.583111</td>
<td>0.0217</td>
</tr>
<tr>
<td>AR(4)</td>
<td>-0.588873</td>
<td>0.189660</td>
<td>-3.104886</td>
<td>0.0078</td>
</tr>
<tr>
<td>MA(2)</td>
<td>-0.765513</td>
<td>0.135035</td>
<td>-5.669003</td>
<td>0.0001</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.989178</td>
<td>0.353770</td>
<td>2.796106</td>
<td>0.0143</td>
</tr>
</tbody>
</table>

R-squared          | 0.924657 | Mean dependent var | 0.003063|
Adjusted R-squared | 0.860078 | S.D. dependent var  | 0.055373|
S.E. of regression | 0.020713 | Akaike info criteria| -4.609931|
Sum squared resid   | 0.006006 | Schwarz criterion   | -3.986010|
Log likelihood      | 75.23407 | F-statistic         | 14.31815|
Durbin-Watson stat  | 2.190051 | Prob(F-statistic)   | 0.000008|

Inverted AR Roots  | .24+.81i | .24-.81i | -.79+.44i | -.79-.44i|
Inverted MA Roots   | .83-.55i | .83+.55i | -.83-.55i | -.83+.55i|
15.2. Regression of real exports of goods and services on merchandise exports (in U.S. dollars)

\[ DLEXPGS = C(1) + C(2) \times DLEXPORTS + C(3) \times DLEXPORTS(-1) + C(4) \times DLEXPORTS(-2) + C(5) \times DUMMYDLEXPORTS(-2) + [AR(1)=C(6), AR(2)=C(7), AR(3)=C(8), MA(4)=C(9), BACKCAST=1997Q3] \]

15.3. Regression of real exports of goods and services on Brent crude oil spot price

\[ DLEXPGS = C(1) + C(2) \times DLBRENT + C(3) \times DLBRENT(-1) + C(4) \times DUMMYDLBRENT(-1) + [AR(1)=C(5), AR(2)=C(6), AR(3)=C(7), AR(4)=C(8), MA(4)=C(9), BACKCAST=1997Q3] \]

15.4. Regression of real exports of goods and services on crude oil production

\[ DLEXPGS = C(1) + C(2) \times DLEXPGS(-1) + C(3) \times DUMMYDLCRUDEOIL(-3) + C(4) \times DLCRUDEOIL(-4) + [MA(2)=C(5), BACKCAST=1997Q2] \]

15.5. Regression of real exports of goods and services on steel production

\[ DLEXPGS = C(1) + C(2) \times DLEXPGS(-1) + C(3) \times DUMMYDLEXPGS(-1) + C(4) \times DUMMYDLCRUEOIL + C(5) \times DLCRUEOIL(-3) + C(6) \times DLCRUEOIL(-4) + C(7) \times DUMMYDLCRUEOIL(-4) + [AR(1)=C(8), AR(2)=C(9), MA(2)=C(10), BACKCAST=1997Q4] \]

15.6. Regression of real exports of goods and services on real ruble/U.S. dollar exchange rate

\[ DLEXPGS = C(1) + C(2) \times DLREALEXRATE + C(3) \times DUMDLREALEXRATE + C(4) \times DLREALEXRATE(-1) + C(5) \times DLREALEXRATE(-4) + [AR(1)=C(6), AR(2)=C(7), AR(3)=C(8), MA(4)=C(9), BACKCAST=1998Q1] \]

15.7. Regression of real exports of goods and services on merchandise exports (in U.S. dollars) and principal components (no contemporaneous independent variables)

\[ DLEXPGS = C(1) + C(2) \times DLEXPORTS(-2) + C(3) \times PC2(-1) + C(4) \times PC5(-1) + C(5) \times DUMMYPC5(-1) + C(6) \times PC1(-2) + C(7) \times DUMMYPC1(-2) + [AR(1)=C(8), AR(2)=C(9), AR(3)=C(10), MA(4)=C(11), BACKCAST=1997Q3] \]

15.8. Regression of real exports of goods and services on principal components (no contemporaneous independent variables, no crisis dummy variables)

\[ DLEXPGS = C(1) + C(2) \times PC5(-1) + C(3) \times PC1(-2) + [AR(1)=C(4), AR(2)=C(5), AR(3)=C(6), MA(4)=C(7), BACKCAST=1997Q3] \]
15.9. Regression of real exports of goods and services on merchandise exports (in U.S. dollars) (no contemporaneous independent variables)

\[ DLEXPGS = C(1) + C(2) \times DLEXPORTS(-2) + \]
\[ AR(1) = C(3), AR(2) = C(4), AR(3) = C(5), MA(4) = C(6), BACKCAST = 1997Q3 \]

15.10. ARMA merchandise exports regression

\[ DLEXPORTS = C(1) + C(2) \times DUMMYDLEXPORTS(-2) + \]
\[ AR(1) = C(3), AR(2) = C(4), MA(4) = C(5), BACKCAST = 1997Q2 \]

15.11. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \times DUMMY8 + C(3) \times DUMMY9 + C(4) \times PC1(-1) + C(5) \times PC1(-3) + C(6) \times DUMMYPIC1(-3) + [MA(3) = C(7), MA(4) = C(8), BACKCAST = 1997Q1] \]

15.12. ARMA PC8 regression

\[ PC8 = C(1) + C(2) \times PC8(-3) + \]
\[ AR(2) = C(3), AR(3) = C(4), MA(4) = C(5), BACKCAST = 1997Q4 \]
Table 15.1. Exports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>13.28%</td>
<td>12.62%</td>
</tr>
<tr>
<td>Merchandise exports (in U.S. dollars)</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>35.85%</td>
<td>39.14%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Merchandise exports and PCs</td>
<td>15.1</td>
<td>Full</td>
<td>No</td>
<td>14.50%</td>
<td>11.63%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Merchandise exports</td>
<td>15.2</td>
<td>Full</td>
<td>Yes</td>
<td>17.14%</td>
<td>16.60%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>15.3</td>
<td>Full</td>
<td>Yes</td>
<td>16.22%</td>
<td>15.72%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Crude oil spot price production</td>
<td>15.4</td>
<td>Full</td>
<td>Yes</td>
<td>14.74%</td>
<td>17.86%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Steel production</td>
<td>15.5</td>
<td>Full</td>
<td>Yes</td>
<td>11.28%</td>
<td>15.83%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real ruble/dollar exchange rate</td>
<td>15.6</td>
<td>Full</td>
<td>Yes</td>
<td>14.93%</td>
<td>16.31%</td>
</tr>
</tbody>
</table>
Table 15.2. Exports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.62%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Merchandise exports and PCs</td>
<td>15.7</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>13.64%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Merchandise exports and PCs</td>
<td>15.8</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>15.07%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Merchandise exports</td>
<td>15.9</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>14.82%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Merchandise exports and PCs</td>
<td>15.1</td>
<td>Full</td>
<td>No</td>
<td>Yes</td>
<td>11.26%</td>
</tr>
</tbody>
</table>
16. Imports

Variables

The dependent variable: real imports of goods and services, the difference of the logarithms of the year-over-year indices – DLIMPGS

Special indicator: merchandise imports (in U.S. dollars), the difference of the logarithms of the year-over-year indices – DLIMPORTS

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real retail sales
- Real inventories in retail sales
- Real consumer spending on goods and services
- Freight transportation (in tons-kilometers)
- Real Industrial production
- Merchandise exports to CIS (in U.S. dollar)
- Merchandise exports outside CIS (in U.S. dollars)
- Employment
- Unemployment real
- Real average wage
- Real ruble/U.S. dollar exchange rate
- Real M2
- Ratio of consolidated government budget expenditures to revenues
- Ratio of defense expenditures to total consolidated government budget expenditures
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer prices to freight transportation prices
- Brent crude oil spot price (in U.S. dollars)
Real Import Regressions

16.1. Regression of real imports of goods and services on merchandise imports (in U.S. dollars) and principal components

\[ \text{DLIMPGS} = C(1) + C(2) \times \text{DLIMPGS}(-4) + C(3) \times \text{DLIMPORTS} + C(4) \times \text{PC1} + C(5) \times \text{PC2} + C(6) \times \text{PC7} + C(7) \times \text{PC1}(-4) + [\text{AR}(4)=C(8), \text{MA}(3)=C(9), \text{BACKCAST}=1998Q2] \]

Dependent Variable: DLIMPGS
Method: Least Squares

Sample (adjusted): 1998Q2 2004Q3
Included observations: 26 after adjustments
Convergence achieved after 18 iterations
Backcast: 1997Q3 1998Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1.88E-05</td>
<td>0.002238</td>
<td>0.008381</td>
<td>0.9934</td>
</tr>
<tr>
<td>DLIMPGS(-4)</td>
<td>0.282922</td>
<td>0.062997</td>
<td>4.491008</td>
<td>0.0003</td>
</tr>
<tr>
<td>DLIMPORTS</td>
<td>0.749379</td>
<td>0.081048</td>
<td>9.246148</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.008095</td>
<td>0.006420</td>
<td>-1.260822</td>
<td>0.2244</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.052925</td>
<td>0.012901</td>
<td>-4.102400</td>
<td>0.0007</td>
</tr>
<tr>
<td>PC7</td>
<td>0.028473</td>
<td>0.022823</td>
<td>1.247561</td>
<td>0.2291</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>0.023238</td>
<td>0.007112</td>
<td>3.267418</td>
<td>0.0045</td>
</tr>
<tr>
<td>AR(4)</td>
<td>-0.739881</td>
<td>0.152806</td>
<td>-4.841957</td>
<td>0.0002</td>
</tr>
<tr>
<td>MA(3)</td>
<td>-0.992336</td>
<td>0.216925</td>
<td>-4.574559</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

R-squared       0.970476          Mean dependent var 0.004156
Adjusted R-squared 0.956582          S.D. dependent var 0.137447
S.E. of regression    0.028640          Akaike info criterion -4.000622
Sum squared resid    0.013944          Schwarz criterion -3.565127
Log likelihood       61.00809          F-statistic 69.84990
Durbin-Watson stat   2.330287          Prob(F-statistic) 0.000000

Inverted AR Roots  .66-.66i  .66-.66i  -.66+.66i  -.66+.66i
Inverted MA Roots  1.00  -.50+.86i  -.50-.86i
16.2. Regression of real imports of goods and services on merchandise imports (in U.S. dollars) and principal components (a crisis dummy variable is included)

\[ DLIMPGS = C(1) + C(2)*DLIMPGS(-4) + C(3)*DLIMPORTS + C(4)*PC1 + C(5)*DUMMYPC2 + C(6)*PC1(-4) + [AR(4)=C(7),MA(3)=C(8),BACKCAST=1998Q2] \]

16.3. Regression of real imports of goods and services on merchandise imports (in U.S. dollars)

\[ DLIMPGS = C(1) + C(2)*DLIMPORTS + [AR(3)=C(3),MA(3)=C(4),BACKCAST=1997Q1] \]

16.4. Regression of real imports of goods and services on Brent crude oil spot price

\[ DLIMPGS = C(1) + C(2)*DUMMY2 + C(3)*DLIMPGS(-3) + C(4)*DLBRENT + C(5)*DLBRENT(-2) + C(6)*DUMMYDLBRENT(-2) + [AR(3)=C(7),MA(3)=C(8),BACKCAST=1997Q4] \]

16.5. Regression of real imports of goods and services on the real ruble/U.S. dollar exchange rate

\[ DLIMPGS = C(1) + C(2)*DLREALEXRATE + C(3)*DUMMYDLREALEXRATE + C(4)*DLREALEXRATE(-2) + C(5)*DLREALEXRATE(-3) + C(6)*DLREALEXRATE(-4) + [MA(1)=C(7),MA(4)=C(8),BACKCAST=1997Q2] \]

16.6. Regression of real imports of goods and services on real industrial production

\[ DLIMPGS = C(1) + C(2)*DUMMY2 + C(3)*DLIND(-1) + C(4)*DUMMYDLIND(-1) + C(5)*DLIND(-2) + C(6)*DLIND(-4) + [AR(1)=C(7),AR(3)=C(8),MA(4)=C(9),BACKCAST=1998Q1] \]

16.7. Regression of real imports of goods and services on real M2

\[ DLIMPGS = C(1) + C(2)*DUMMY2 + C(3)*DLIMPGS(-2) + C(4)*DLREALM2 + C(5)*DLREALM2(-2) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997Q1] \]

16.8. Regression of real imports of goods and services on merchandise imports (in U.S. dollars) and principal components (no contemporaneous independent variables)

\[ DLIMPGS = C(1) + C(2)*DUMMY2 + C(3)*DLIMPORTS(-1) + C(4)*PC1(-1) + C(5)*DUMMYPC1(-1) + C(6)*PC13(-1) + [AR(4)=C(7),MA(3)=C(8),BACKCAST=1997Q3] \]
16.9. ARMA merchandise imports regression (post-crisis sample)

\[ DLIMPORTS = C(1) + [AR(3)=C(2),MA(3)=C(3),BACKCAST=1999Q3] \]

16.10. ARMA PC1 regression

\[ PC1 = C(1) + C(2)*DUMMY8 + C(3)*DUMMY9 + C(4)*PC1(-1) + C(5)*DUMMYPC1(-1) + C(6)*PC1(-2) + [AR(3)=C(7)] \]

16.10. ARMA PC2 regression (post-crisis sample)

\[ PC2 = C(1) + [MA(4)=C(2),MA(5)=C(3),BACKCAST=1998Q4] \]

16.12. ARMA PC7 regression

\[ PC7 = C(1) + C(2)*PC7(-1) + C(3)*PC7(-2) + C(4)*DUMMYP7(-4) + [AR(3)=C(5),MA(5)=C(6),BACKCAST=1998Q1] \]
Table 16.1. Imports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real imports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>24.17%</td>
<td>24.69%</td>
</tr>
<tr>
<td>Merchandise imports (in U.S. dollars)</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>26.52%</td>
<td>26.29%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Merchandise imports and PCs</td>
<td>16.1.</td>
<td>Full</td>
<td>No</td>
<td>25.17%</td>
<td>24.33%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Merchandise imports and PCs</td>
<td>16.2.</td>
<td>Full</td>
<td>Yes</td>
<td>22.93%</td>
<td>21.22%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>16.3.</td>
<td>Full</td>
<td>No</td>
<td>25.49%</td>
<td>26.51%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>16.4.</td>
<td>Full</td>
<td>Yes</td>
<td>32.42%</td>
<td>31.68%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real ruble/dollar exchange rate</td>
<td>16.5.</td>
<td>Full</td>
<td>Yes</td>
<td>15.74%</td>
<td>14.51%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real retail industrial production</td>
<td>16.6.</td>
<td>Full</td>
<td>Yes</td>
<td>16.97%</td>
<td>17.39%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real M2</td>
<td>16.7.</td>
<td>Full</td>
<td>Yes</td>
<td>20.21%</td>
<td>7.58%</td>
</tr>
</tbody>
</table>
Table 16.2. Imports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real imports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>24.69%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Merchandise imports and PCs</td>
<td>16.8.</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>25.32%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Merchandise imports and PCs</td>
<td>16.1.</td>
<td>Full *</td>
<td>No</td>
<td>Yes</td>
<td>24.42%</td>
</tr>
</tbody>
</table>

Note: * Merchandise imports and PC2 are forecasted on the basis of the post-crisis sample
17. Nominal GDP

Variables

The dependent variable: nominal GDP, the difference of the logarithms of the year-over-year indices \( DLNGDP \)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real industrial production
- Real construction
- Real retail sales
- Freight transportation (in ton-kilometers)
- Nominal inventories in retail sales
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Employment
- Nominal average wage
- Nominal ruble/U.S. dollar exchange rate
- Nominal M2
- Nominal consolidated government budget expenditures
- Nominal consolidated government budget revenues
- Animal husbandry producer prices
- Industrial producer prices
- Construction prices
- Freight transportation prices
- Consumer prices
- Brent crude oil spot price (in U.S. dollars)
Nominal GDP Regressions

17.1. Regression of nominal GDP on principal components

\[ DLNGDP = C(1) + C(2)*PC1 + C(3)*PC2 + C(4)*PC1(-1) + C(5)*DUMMYPC1(-1) + [MA(4)=C(6), BACKCAST=1996Q3] \]

Dependent Variable: DLNGDP
Method: Least Squares

Sample (adjusted): 1996Q3 2004Q3
Included observations: 33 after adjustments
Convergence achieved after 12 iterations
Backcast: 1995Q3 1996Q2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.020183</td>
<td>0.002382</td>
<td>-8.473293</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.020971</td>
<td>0.006459</td>
<td>-3.246731</td>
<td>0.0031</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.009951</td>
<td>0.006790</td>
<td>-1.465605</td>
<td>0.1543</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.020671</td>
<td>0.009332</td>
<td>-2.215067</td>
<td>0.0354</td>
</tr>
<tr>
<td>DUMMYPC1(-1)</td>
<td>-0.016056</td>
<td>0.007462</td>
<td>-2.151803</td>
<td>0.0405</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.932401</td>
<td>0.028671</td>
<td>-32.52101</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.916607  Mean dependent var -0.003504
Adjusted R-squared 0.901164 S.D. dependent var 0.077605
S.E. of regression 0.024398 Akaike info criterion -4.425689
Sum squared resid 0.016072 Schwarz criterion -4.153597
Log likelihood 79.02388 F-statistic 59.35373
Durbin-Watson stat 2.169268 Prob(F-statistic) 0.000000

Inverted MA Roots .98 -.00+.98i -.00-.98i -.98
17.2. Regression of nominal GDP on principal components (no crisis dummy variables)

\[ DLNGDP = C(1) + C(2)\cdot PC1 + C(3)\cdot PC2 + C(4)\cdot PC1(-1) + \]
\[ \quad [MA(4)=C(5),BACKCAST=1996:3] \]

17.3. Regression of nominal GDP on Brent crude oil spot price (post-crisis sample)

\[ DLNGDP = C(1) + C(2)\cdot DLBRENT + [AR(1)=C(3),MA(4)=C(4),BACKCAST=1999:1] \]

17.4. Regression of nominal GDP on real retail sales

\[ DLNGDP = C(1) + C(2)\cdot DLNGDP(-1) + C(3)\cdot DLNGDP(-2) + C(4)\cdot DLNGDP(-3) + C(5)\cdot DLRETSales + C(6)\cdot DLRETSales(-4) + \]
\[ \quad [AR(1)=C(7),MA(4)=C(8),BACKCAST=1997:3] \]

17.5. Regression of nominal GDP on nominal M2

\[ DLNGDP = C(1) + C(2)\cdot DLNGDP(-2) + C(3)\cdot DLM2 + C(4)\cdot DLM2(-2) + C(5)\cdot DUMMYDLM2(-2) + \]
\[ \quad [AR(1)=C(6),AR(2)=C(7),AR(3)=C(8),MA(4)=C(9),BACKCAST=1997:3] \]

17.6. Regression of nominal GDP on consumer prices

\[ DLNGDP = C(1) + C(2)\cdot DLNGDP(-2) + C(3)\cdot DLCPI + C(4)\cdot DLCPI(-1) + C(5)\cdot DUMMYDLCPI(-1) + C(6)\cdot DLCPI(-4) + \]
\[ \quad [AR(1)=C(7),AR(2)=C(8),MA(4)=C(9),BACKCAST=1997:4] \]

17.7. Regression of nominal GDP on industrial producer prices

\[ DLNGDP = C(1) + C(2)\cdot DLIPI + C(3)\cdot DUMMYDLIPI + \]
\[ \quad [MA(4)=C(4),BACKCAST=1996Q2] \]

17.8. Regression of nominal GDP on nominal average wage

\[ DLNGDP = C(1) + C(2)\cdot DLNWG + C(3)\cdot DLNOMWAGE + C(4)\cdot DLNOMWAGE(-1) + C(5)\cdot DLNOMWAGE(-4) + \]
\[ \quad [AR(1)=C(6),AR(3)=C(7),AR(4)=C(8),MA(4)=C(9),BACKCAST=1998:2] \]

17.9. Regression of nominal GDP on principal components (no contemporaneous independent variables)

\[ DLNGDP = C(1) + C(2)\cdot PC1(-1) + C(3)\cdot DUMMYPC1(-1) + C(4)\cdot PC2(-1) + C(5)\cdot PC4(-1) + C(6)\cdot PC9(-1) + [MA(4)=C(7),BACKCAST=1996:3] \]
17.10. Regression of nominal GDP on principal components (no contemporaneous independent variables, no crisis dummy variables)

\[ DLNGDP = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot PC2(-1) + C(4) \cdot PC4(-1) + C(5) \cdot PC9(-1) + [MA(4)=C(6), BACKCAST=1996:3] \]

17.11. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \cdot DUMMY8 + C(3) \cdot PC1(-1) + C(4) \cdot PC1(-2) + [AR(1)=C(5), AR(3)=C(6), MA(3)=C(7), BACKCAST=1997Q3] \]

17.12. ARMA PC2 regression

\[ PC2 = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot PC2(-1) + C(4) \cdot PC2(-2) + C(5) \cdot PC2(-4) + C(6) \cdot DUMMYPC2(-4) + [AR(3)=C(7), MA(3)=C(8), BACKCAST=1998:1] \]
Table 17.1. Nominal GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>26.92%</td>
<td>28.66%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>PCs</td>
<td>17.1</td>
<td>Full</td>
<td>Yes</td>
<td>27.61%</td>
<td>28.47%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>PCs</td>
<td>17.2</td>
<td>Full</td>
<td>No</td>
<td>26.06%</td>
<td>25.08%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>Brent crude oil spot price</td>
<td>17.3</td>
<td>Post-Crisis</td>
<td>N/A</td>
<td>29.28%</td>
<td>31.28%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>Real retail sales</td>
<td>17.4</td>
<td>Full</td>
<td>Yes</td>
<td>25.83%</td>
<td>30.72%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>Nominal M2</td>
<td>17.5</td>
<td>Full</td>
<td>Yes</td>
<td>15.01%</td>
<td>5.67%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>Consumer prices</td>
<td>17.6</td>
<td>Full</td>
<td>Yes</td>
<td>23.40%</td>
<td>28.28%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>Industrial producer prices</td>
<td>17.7</td>
<td>Full</td>
<td>Yes</td>
<td>30.11%</td>
<td>33.00%</td>
<td></td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>Nominal average wage</td>
<td>17.8</td>
<td>Full</td>
<td>No</td>
<td>28.15%</td>
<td>28.19%</td>
<td></td>
</tr>
</tbody>
</table>
Table 17.2. Nominal GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>28.66%</td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>PCs</td>
<td>17.9</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>28.85%</td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>PCs</td>
<td>17.10</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>27.20%</td>
</tr>
<tr>
<td>Nominal GDP Forecast</td>
<td>PCs</td>
<td>17.1</td>
<td>Full</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>27.83%</td>
</tr>
</tbody>
</table>
Table 17.3. Partial Derivatives of Nominal GDP with Respect to:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Partial Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural production</td>
<td>0.0044</td>
</tr>
<tr>
<td>Real industrial production</td>
<td>0.0056</td>
</tr>
<tr>
<td>Real construction</td>
<td>0.0011</td>
</tr>
<tr>
<td>Real retail sales</td>
<td>-0.0007</td>
</tr>
<tr>
<td>Freight transportation (in ton-kilometers)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Nominal inventories in retail sales</td>
<td>0.0075</td>
</tr>
<tr>
<td>Merchandise exports (in U.S. dollars)</td>
<td>0.0029</td>
</tr>
<tr>
<td>Merchandise imports (in U.S. dollars)</td>
<td>0.0008</td>
</tr>
<tr>
<td>Employment</td>
<td>0.0011</td>
</tr>
<tr>
<td>Nominal average wage</td>
<td>0.0066</td>
</tr>
<tr>
<td>Nominal ruble/U.S. dollar exchange rate</td>
<td>0.0032</td>
</tr>
<tr>
<td>Nominal M2</td>
<td>0.0079</td>
</tr>
<tr>
<td>Nominal consolidated government budget expenditures</td>
<td>0.0050</td>
</tr>
<tr>
<td>Nominal consolidated government budget revenues</td>
<td>0.0056</td>
</tr>
<tr>
<td>Animal husbandry producer prices</td>
<td>0.0079</td>
</tr>
<tr>
<td>Industrial producer prices</td>
<td>0.0095</td>
</tr>
<tr>
<td>Construction prices</td>
<td>0.0048</td>
</tr>
<tr>
<td>Freight transportation prices</td>
<td>0.0029</td>
</tr>
<tr>
<td>Consumer prices</td>
<td>0.0068</td>
</tr>
<tr>
<td>Brent crude oil spot price (in U.S. dollars)</td>
<td>0.0042</td>
</tr>
</tbody>
</table>
18. Nominal Employees’ Compensation

Variables

The dependent variable: nominal employees’ compensation, including hidden, the
difference of the logarithms of the year-over-year indices – DLNEC

The special variable: nominal average wage, the difference of the logarithms of the
year-over-year indices – DLNOMWAGE

The set of monthly indicators used in the extraction of the principal
components (PC’s):

- Real agricultural production
- Real industrial production
- Real construction
- Real retail sales
- Freight transportation (in ton-kilometers)
- Nominal inventories in retail sales
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Employment
- Nominal gross per capita income
- Nominal wage arrears
- Nominal ruble/U.S. dollar exchange rate
- Nominal M2
- Nominal consolidated government budget expenditures
- Nominal consolidated government budget revenues
- Animal husbandry producer prices
- Industrial producer prices
- Construction prices
- Freight transportation prices
- Consumer prices
- Brent crude oil spot price (in U.S. dollars)
Nominal Employees’ Compensation Regressions

18.1. Regression of nominal employees’ compensation on nominal average wage and principal components

\[
DLNEC = C(1) + C(2)*DLNOMWAGE(-1) + C(3)*PC1(-1) + C(4)*PC5(-1) + C(5)*PC8(-1) + C(6)*PC1(-2) + C(7)*DUMMYPC1(-2) + [AR(1)=C(8),AR(2)=C(9),MA(4)=C(10),BACKCAST=1997:2]
\]

Dependent Variable: DLNEC
Method: Least Squares

Sample(adjusted): 1997:2 2004:3
Included observations: 30 after adjusting endpoints
Convergence achieved after 12 iterations
Backcast: 1996:2 1997:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.005069</td>
<td>0.001520</td>
<td>-3.333774</td>
<td>0.0033</td>
</tr>
<tr>
<td>DLNOMWAGE(-1)</td>
<td>0.410675</td>
<td>0.141103</td>
<td>2.910462</td>
<td>0.0086</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.028284</td>
<td>0.007684</td>
<td>-3.680711</td>
<td>0.0015</td>
</tr>
<tr>
<td>PC5(-1)</td>
<td>0.017916</td>
<td>0.010654</td>
<td>1.681598</td>
<td>0.1082</td>
</tr>
<tr>
<td>PC8(-1)</td>
<td>0.038459</td>
<td>0.012295</td>
<td>3.127935</td>
<td>0.0053</td>
</tr>
<tr>
<td>PC1(-2)</td>
<td>-0.035907</td>
<td>0.016271</td>
<td>-2.206854</td>
<td>0.0392</td>
</tr>
<tr>
<td>DUMMYPC1(-2)</td>
<td>0.027177</td>
<td>0.010482</td>
<td>2.592830</td>
<td>0.0174</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.974274</td>
<td>0.171751</td>
<td>-5.672600</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.606520</td>
<td>0.178363</td>
<td>-3.400486</td>
<td>0.0028</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.989836</td>
<td>0.057220</td>
<td>-17.29891</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.929210  Mean dependent var: -3.32E-05
Adjusted R-squared: 0.897354  S.D. dependent var: 0.081159
S.E. of regression: 0.026002  Akaike info criterion: -4.200072
Sum squared resid: 0.013522  Schwarz criterion: -3.733006
Log likelihood: 73.00108  F-statistic: 29.16936
Durbin-Watson stat: 2.182325  Prob(F-statistic): 0.000000

Inverted AR Roots: -.49+.61i  -.49-.61i
Inverted MA Roots: 1.00
18.2. Regression of nominal employees’ compensation on nominal average wage and principal components (no crisis dummies)

\[ DLNEC = C(1) + C(2) \times DLNOMWAGE(-1) + C(3) \times PC1(-1) + C(4) \times PC8(-1) + [AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997:1] \]

18.3. Regression of nominal employees’ compensation on nominal average wage

\[ DLNEC = C(1) + C(2) \times DLNWAGENA(-2) + C(3) \times DLNOMWAGE(-1) + [MA(1)=C(4),MA(4)=C(5),BACKCAST=1996:4] \]
Table 18.1. Nominal Employees’ Compensation Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal employees’ compensation</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>24.60%</td>
</tr>
<tr>
<td>Nominal employees’ compensation</td>
<td>Forecast</td>
<td>Nominal average wage and PCs</td>
<td>18.1</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>24.76%</td>
</tr>
<tr>
<td>Nominal employees’ compensation</td>
<td>Forecast</td>
<td>Nominal average wage and PCs</td>
<td>18.2</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>26.59%</td>
</tr>
<tr>
<td>Nominal employees’ compensation</td>
<td>Forecast</td>
<td>Nominal average wage</td>
<td>18.3</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>21.92%</td>
</tr>
</tbody>
</table>
19. Nominal Profit and Mixed Income

Variables

The dependent variable: nominal profit and mixed income, the difference of the logarithms of the year-over-year indices – DLPROFIT

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real industrial production
- Real construction
- Real retail sales
- Freight transportation (in ton-kilometers)
- Nominal inventories in retail sales
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Employment
- Nominal gross per capita income
- Nominal wage arrears
- Nominal ruble/U.S. dollar exchange rate
- Nominal M2
- Nominal consolidated government budget expenditures
- Nominal consolidated government budget revenues
- Animal husbandry producer prices
- Industrial producer prices
- Construction prices
- Freight transportation prices
- Consumer prices
- Brent crude oil spot price (in U.S. dollars)
**Nominal Profit and Mixed Income Regressions**

### 19.1. Regression of nominal profit and mixed income on principal components

\[
DLPROFIT = C(1) + C(2)\cdot PC1 + C(3)\cdot PC7 + C(4)\cdot PC8 + C(5)\cdot PC3(-1) + \\
C(6)\cdot PC4(-3) + C(7)\cdot PC1(-4) + C(8)\cdot DUMMYPC1(-4) + \\
[AR(1)=C(9), MA(4)=C(10), BACKCAST=1997Q3]
\]

Dependent Variable: DLPROFIT  
Method: Least Squares  
Sample (adjusted): 1997Q3 2004Q3  
Included observations: 29 after adjustments  
Convergence achieved after 12 iterations  
Backcast: 1996Q3 1997Q2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.005407</td>
<td>0.004453</td>
<td>-1.214247</td>
<td>0.2395</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.070737</td>
<td>0.005805</td>
<td>-12.18649</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC7</td>
<td>0.046770</td>
<td>0.018912</td>
<td>2.472983</td>
<td>0.0230</td>
</tr>
<tr>
<td>PC8</td>
<td>-0.020215</td>
<td>0.016782</td>
<td>-1.204583</td>
<td>0.2432</td>
</tr>
<tr>
<td>PC3(-1)</td>
<td>-0.027604</td>
<td>0.007990</td>
<td>-3.454978</td>
<td>0.0027</td>
</tr>
<tr>
<td>PC4(-3)</td>
<td>0.017634</td>
<td>0.011567</td>
<td>1.524547</td>
<td>0.1438</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>0.036238</td>
<td>0.010389</td>
<td>3.488034</td>
<td>0.0025</td>
</tr>
<tr>
<td>DUMMYPC1(-4)</td>
<td>-0.043629</td>
<td>0.013379</td>
<td>-3.260880</td>
<td>0.0041</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.949336</td>
<td>0.103726</td>
<td>-9.152301</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.974059</td>
<td>0.033134</td>
<td>-29.39718</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| R-squared               | 0.957324    | Mean dependent var | 0.008557 |
| Adjusted R-squared      | 0.937109    | S.D. dependent var  | 0.137587 |
| S.E. of regression      | 0.034504    | Akaike info criterion | -3.628666 |
| Sum squared resid       | 0.022620    | Schwarz criterion   | -3.157184 |
| Log likelihood          | 62.61565    | F-statistic         | 47.35708  |
| Durbin-Watson stat      | 2.386448    | Prob(F-statistic)   | 0.000000  |

Inverted AR Roots        | -.95        |                      |            |
Inverted MA Roots        | .99         | .00+.99i             | -.00-.99i  | -.99
19.2. Regression of nominal profit and mixed income on principal components (no crisis dummy variables)

\[ DLPROFIT = C(1) + C(2)*PC1 + C(3)*PC3(-1) + C(4)*PC4(-3) + C(5)*PC1(-4) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997Q3] \]

19.3. Regression of nominal profit and mixed income on Brent crude oil spot price

\[ DLPROFIT = C(1) + C(2)*DUMMY2 + C(3)*DLBRENT + C(4)*DLBRENT(-3) + [AR(3)=C(5),MA(2)=C(6),MA(4)=C(7),BACKCAST=1997Q4] \]

19.4. Regression of nominal profit and mixed income on consumer prices

\[ DLPROFIT = C(1) + C(2)*DLPROFIT(-1) + C(3)*DLCPI + C(4)*DUMMYDLCPI(-4) + [AR(1)=C(5),MA(4)=C(6),BACKCAST=1997Q3] \]

19.5. Regression of nominal profit and mixed income on industrial producer prices

\[ DLPROFIT = C(1) + C(2)*DLIPI + C(3)*DLIPI(-1) + [AR(1)=C(4),MA(4)=C(5),BACKCAST=1996Q4] \]

19.6. Regression of nominal profit and mixed income on nominal M2

\[ DLPROFIT = C(1) + C(2)*DLPROFIT(-1) + C(3)*DLM2 + C(4)*DUMMYDLM2 + [AR(1)=C(5),AR(4)=C(6),MA(4)=C(7),BACKCAST=1997Q3] \]

19.7. Regression of nominal profit and mixed income on real industrial production

\[ DLPROFIT = C(1) + C(2)*DUMMY2 + C(3)*DLPROFIT(-1) + C(4)*DLIND(-1) + C(5)*DUMMYDLIND(-1) + [AR(1)=C(6),AR(4)=C(7),MA(4)=C(8),BACKCAST=1997Q3] \]

19.8. Regression of nominal profit and mixed income on merchandise exports (in U.S dollars)

\[ DLPROFIT = C(1) + C(2)*DLEXBOP(-1) + C(3)*DLEXBOP(-2) + C(4)*DUMMYDLEXBOP(-2) + C(5)*DLEXBOP(-4) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997Q3] \]

19.9. Regression of nominal profit and mixed income on principal components (no contemporaneous independent variables)

\[ DLPROFIT = C(1) + C(2)*DLPROFIT(-1) + C(3)*PC1(-1) + C(4)*PC3(-1) + C(5)*PC9(-1) + C(6)*PC1(-4) + [AR(4)=C(7),MA(4)=C(8),BACKCAST=1998Q2] \]
19.10. Regression of nominal profit and mixed income on principal components (no contemporaneous independent variables; a crisis dummy variable is included)

\[
DLPROFIT = C(1) + C(2)\cdot DLPROFIT(-1) + C(3)\cdot DUMMYDLPROFIT(-1) + C(4)\cdot PC1(-1) + C(5)\cdot PC3(-1) + C(6)\cdot PC9(-1) + C(7)\cdot PC1(-4) + [AR(4)=C(8),MA(4)=C(9),BACKCAST=1998Q2]
\]

19.11. ARMA PC1 regression

\[
PC1 = C(1) + C(2)\cdot DUMMY8 + C(3)\cdot PC1(-1) + C(4)\cdot PC1(-2) + [AR(1)=C(5),AR(3)=C(6),MA(3)=C(7),BACKCAST=1997Q3]
\]

19.12. ARMA PC7 regression (post-crisis sample)

\[
PC7 = C(1) + C(2)\cdot DUMMYP7C(-4) + [MA(4)=C(3),BACKCAST=1999Q4]
\]

19.13. ARMA PC8 regression

\[
PC8 = C(1) + C(2)\cdot DUMMY2 + [MA(4)=C(3),BACKCAST=1996Q2]
\]
Table 19.1. Nominal Profit and Mixed Income Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal profit and mixed income</td>
<td>Official N/A</td>
<td>N/A N/A N/A N/A</td>
<td></td>
<td></td>
<td></td>
<td>31.28%</td>
<td>31.11%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast PCs</td>
<td>19.1 Full Yes</td>
<td></td>
<td></td>
<td></td>
<td>32.47%</td>
<td>32.13%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast PCs</td>
<td>19.2 Full No</td>
<td></td>
<td></td>
<td></td>
<td>26.53%</td>
<td>26.93%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast Brent crude oil spot price</td>
<td>19.3 Full Yes</td>
<td></td>
<td></td>
<td></td>
<td>23.27%</td>
<td>26.13%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast Consumer prices</td>
<td>19.4 Full Yes</td>
<td></td>
<td></td>
<td></td>
<td>21.40%</td>
<td>25.45%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast Industrial producer prices</td>
<td>19.5 Full No</td>
<td></td>
<td></td>
<td></td>
<td>29.02%</td>
<td>29.49%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast Nominal M2</td>
<td>19.6 Full Yes</td>
<td></td>
<td></td>
<td></td>
<td>26.94%</td>
<td>38.18%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast Real industrial production</td>
<td>19.7 Full Yes</td>
<td></td>
<td></td>
<td></td>
<td>16.32%</td>
<td>8.75%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast Merchandise exports</td>
<td>19.8 Full Yes</td>
<td></td>
<td></td>
<td></td>
<td>21.62%</td>
<td>28.78%</td>
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</tbody>
</table>
Table 19.2. Nominal Profit and Mixed Income Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal profit and mixed income</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>31.11%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast</td>
<td>PCs</td>
<td>19.9</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>30.01%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast</td>
<td>PCs</td>
<td>19.10</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>29.40%</td>
</tr>
<tr>
<td>Nominal profit and mixed income</td>
<td>Forecast</td>
<td>PCs</td>
<td>19.1</td>
<td>Full*</td>
<td>Yes</td>
<td>Yes</td>
<td>30.30%</td>
</tr>
</tbody>
</table>

Note: * PC7 is estimated on the basis of the post-crisis sample
20. Nominal Net Indirect Taxes

Variables

The dependent variable: nominal net indirect taxes on products and imports, the difference of the logarithms of the year-over-year indices – DLNTAX

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real industrial production
- Real construction
- Real retail sales
- Freight transportation (in ton-kilometers)
- Nominal inventories in retail sales
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Employment
- Nominal gross per capita income
- Nominal wage arrears
- Nominal ruble/U.S. dollar exchange rate
- Nominal M2
- Nominal consolidated government budget expenditures
- Nominal consolidated government budget revenues
- Animal husbandry producer prices
- Industrial producer prices
- Construction prices
- Freight transportation prices
- Consumer prices
- Brent crude oil spot price (in U.S. dollars)
Nominal Net Indirect Tax Regressions

20.1. Regression of nominal net taxes on products and imports on principal components

\[ DLNTAX = C(1) + C(2) \times PC1(-1) + C(3) \times PC3(-1) + C(4) \times PC2(-2) + C(5) \times PC1(-4) + C(6) \times PC3(-4) + C(7) \times PC4(-4) + [AR(1)=C(8), MA(4)=C(9), BACKCAST=1997:3] \]

Dependent Variable: DLNTAX
Method: Least Squares

Sample(adjusted): 1997:3 2004:3
Included observations: 29 after adjusting endpoints
Convergence achieved after 16 iterations
Backcast: 1996:3 1997:2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>-0.005776</td>
<td>0.004360</td>
<td>-1.324559</td>
<td>0.2003</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.081302</td>
<td>0.009631</td>
<td>-8.441420</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC3(-1)</td>
<td>-0.030136</td>
<td>0.015927</td>
<td>-1.892158</td>
<td>0.0730</td>
</tr>
<tr>
<td>PC2(-2)</td>
<td>-0.057797</td>
<td>0.019169</td>
<td>-3.015053</td>
<td>0.0068</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>0.040073</td>
<td>0.013708</td>
<td>2.923332</td>
<td>0.0084</td>
</tr>
<tr>
<td>PC3(-4)</td>
<td>0.035759</td>
<td>0.013728</td>
<td>2.604832</td>
<td>0.0169</td>
</tr>
<tr>
<td>PC4(-4)</td>
<td>0.057554</td>
<td>0.015174</td>
<td>3.792836</td>
<td>0.0011</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.986582</td>
<td>0.058406</td>
<td>-16.89164</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.989425</td>
<td>0.018206</td>
<td>-54.34552</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.902720  Mean dependent var -0.006352
Adjusted R-squared 0.863808  S.D. dependent var 0.169027
S.E. of regression 0.062378  Akaike info criterion -2.462076
Sum squared resid 0.077821  Schwarz criterion -2.037742
Log likelihood 44.70010  F-statistic 23.19901
Durbin-Watson stat 2.284269  Prob(F-statistic) 0.000000

Inverted AR Roots -.99
Inverted MA Roots 1.00  .00+1.00i  -.00 -1.00i  -1.00
20.2. Regression of nominal net taxes on products and imports on principal components (a crisis dummy variable included)

\[ DLNTAX = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot PC3(-1) + C(4) \cdot PC2(-2) + C(5) \cdot PC1(-4) + C(6) \cdot DUMMYPC3(-4) + C(7) \cdot PC4(-4) + [AR(1)=C(8), MA(4)=C(9), BACKCAST=1997:3] \]

20.3. Regression of nominal net taxes on products and imports on nominal consolidated government budget revenues

\[ DLNTAX = C(1) + C(2) \cdot DUMCONSBREV + C(3) \cdot DLCONSBUDREV(-2) + C(4) \cdot DLCONSBUDREV(-4) + C(5) \cdot DUMCONSBREV(-4) + [AR(1)=C(6), MA(4)=C(7), BACKCAST=1997:3] \]

20.4. Regression of nominal net taxes on products and imports on Brent crude oil spot price

\[ DLNTAX = C(1) + C(2) \cdot DLBRENT + [AR(1)=C(3), AR(3)=C(4), AR(4)=C(5), MA(4)=C(6), BACKCAST=1997:2] \]

20.5. Regression of nominal net taxes on products and imports on consumer prices

\[ DLNTAX = C(1) + C(2) \cdot DLNTAX(-1) + C(3) \cdot DLCPI(-2) + C(4) \cdot DUMMYDLCPI(-4) + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997:3] \]

20.6. Regression of nominal net taxes on products and imports on industrial producer prices

\[ DLNTAX = C(1) + C(2) \cdot DLIPI + C(3) \cdot DLIPI(-1) + C(4) \cdot DLIPI(-3) + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997:2] \]

20.7. Regression of nominal net taxes on products and imports on merchandise imports (in U.S dollars)

\[ DLNTAX = C(1) + C(2) \cdot DLNTAX(-1) + C(3) \cdot DUMMYDLIMBOPI + C(4) \cdot DLIMBOPI(-2) + C(5) \cdot DLIMBOPI(-3) + [AR(1)=C(6), MA(4)=C(7), BACKCAST=1997:2] \]

20.8. Regression of nominal net taxes on products and imports on nominal M2

\[ DLNTAX = C(1) + C(2) \cdot DLNTAX(-1) + C(3) \cdot DLM2 + C(4) \cdot DLM2(-4) + [AR(4)=C(5), MA(4)=C(6), BACKCAST=1998:2] \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>19.37%</td>
<td>34.70%</td>
<td></td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>20.1</td>
<td>Full</td>
<td>No</td>
<td>20.78%</td>
<td>35.53%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>20.2</td>
<td>Full</td>
<td>Yes</td>
<td>21.13%</td>
<td>35.56%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Nominal consolidated government budget revenues</td>
<td>20.3</td>
<td>Full</td>
<td>Yes</td>
<td>23.14%</td>
<td>44.01%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>20.4</td>
<td>Full</td>
<td>No</td>
<td>30.18%</td>
<td>36.18%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Consumer prices</td>
<td>20.5</td>
<td>Full</td>
<td>Yes</td>
<td>17.72%</td>
<td>24.92%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Industrial producer prices</td>
<td>20.6</td>
<td>Full</td>
<td>No</td>
<td>27.89%</td>
<td>41.16%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>20.7</td>
<td>Full</td>
<td>Yes</td>
<td>17.17%</td>
<td>26.42%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>Nominal M2</td>
<td>Full</td>
<td>No</td>
<td>-0.01%</td>
<td>-6.75%</td>
<td></td>
</tr>
</tbody>
</table>
Table 20.2. Nominal Net Indirect Tax Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables (the sample is reduced by one quarter)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>34.70%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>20.1</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>35.84%</td>
</tr>
<tr>
<td>Nominal net indirect taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>20.2</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>32.71%</td>
</tr>
</tbody>
</table>
21. GDP Deflator

Variables

The dependent variable: GDP deflator, the difference of the logarithms of the year-over-year indices – DLDEFLATOR

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real industrial production
- Nominal ruble/U.S. dollar exchange rate
- Merchandise imports (in U.S. dollars)
- Nominal M2
- Food consumer prices
- Non-food product consumer prices
- Services consumer prices
- Fuel producer prices
- Electricity producer prices
- Ferrous metallurgy producer prices
- Non-ferrous metallurgy producer prices
- Chemical industry producer prices
- Machine-building producer prices
- Food processing industry producer prices
- Light industry producer prices
- Animal husbandry producer prices
- Construction prices
GDP Deflator Regressions

21.1. Regression of GDP deflator on principal components

\[ DLDEFLATOR = C(1) + C(2) \cdot PC1 + C(3) \cdot PC1(-1) + C(4) \cdot PC2(-1) + C(5) \cdot PC2(-2) + C(6) \cdot PC7(-4) + [AR(1)=C(7), MA(4)=C(8), BACKCAST=1997Q3] \]

Dependent Variable: DLDEFLATOR
Method: Least Squares

Sample (adjusted): 1997Q3 2004Q3
Included observations: 29 after adjustments
Convergence achieved after 12 iterations
Backcast: 1996Q3 1997Q2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.019170</td>
<td>0.001319</td>
<td>-14.53524</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.026208</td>
<td>0.003691</td>
<td>-7.101014</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.005137</td>
<td>0.003876</td>
<td>-1.325119</td>
<td>0.1994</td>
</tr>
<tr>
<td>PC2(-1)</td>
<td>0.004803</td>
<td>0.004715</td>
<td>1.018597</td>
<td>0.3200</td>
</tr>
<tr>
<td>PC2(-2)</td>
<td>-0.010486</td>
<td>0.003675</td>
<td>-2.853478</td>
<td>0.0095</td>
</tr>
<tr>
<td>PC7(-4)</td>
<td>-0.035030</td>
<td>0.005777</td>
<td>-6.063570</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.894424</td>
<td>0.135963</td>
<td>-6.578443</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.944425</td>
<td>0.019154</td>
<td>-49.30678</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.966378  Mean dependent var 0.000172
Adjusted R-squared 0.955171  S.D. dependent var 0.064952
S.E. of regression 0.013752  Akaike info criterion -5.506294
Sum squared resid 0.003972  Schwarz criterion -5.129109
Log likelihood 87.84126  F-statistic 86.22836
Durbin-Watson stat 2.270901  Prob(F-statistic) 0.000000

Inverted AR Roots -.89
Inverted MA Roots .99  -.00+.99i  -.00-.99i  -.99
21.2. Regression of GDP deflator on consumer prices

\[ DLDEFLATOR = C(1) + C(2)\cdot DLCPI + C(3)\cdot DLCPI(-2) + C(4)\cdot DLCPI(-4) + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q3] \]

21.3. Regression of GDP deflator on industrial producer prices

\[ DLDEFLATOR = C(1) + C(2)\cdot DUMMY2 + C(3)\cdot DLDEFLATOR(-1) + C(4)\cdot DLIPI + C(5)\cdot DLIPI(-1) + C(6)\cdot DLIPI(-4) + [AR(3)=C(7), MA(4)=C(8), BACKCAST=1998Q1] \]

21.4. Regression of GDP deflator on nominal ruble/U.S. dollar exchange rate

\[ DLDEFLATOR = C(1) + C(2)\cdot DLNOMEXRATE + C(3)\cdot DLNOMEXRATE(-1) + C(4)\cdot DLNOMEXRATE(-3) + [MA(4)=C(5), BACKCAST=1997Q1] \]

21.5. Regression of GDP deflator on merchandise imports in U.S. dollars

\[ DLDEFLATOR = C(1) + C(2)\cdot DLIMBOP + C(3)\cdot DLIMBOP(-1) + C(4)\cdot DLIMBOP(-4) + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q3] \]

21.6. Regression of GDP deflator on nominal M2

\[ DLDEFLATOR = C(1) + C(2)\cdot DLDEFLATOR(-1) + C(3)\cdot DUMMYDLDEFL(-1) + C(4)\cdot DLM2 + C(5)\cdot DLM2(-1) + [AR(1)=C(6), AR(4)=C(7), MA(5)=C(8), BACKCAST=1997Q3] \]

21.7. Regression of GDP deflator on real industrial production

\[ DLDEFLATOR = C(1) + C(2)\cdot DLDEFLATOR(-1) + C(3)\cdot DUMMYDLIND + C(4)\cdot DLIND(-1) + C(5)\cdot DLIND(-2) + C(6)\cdot DUMMYDLIND(-2) + [MA(3)=C(7), BACKCAST=1996Q4] \]

21.8. Regression of GDP deflator on principal components (no contemporaneous independent variables)

\[ DLDEFLATOR = C(1) + C(2)\cdot PC1(-1) + C(3)\cdot PC2(-1) + C(4)\cdot PC3(-1) + C(5)\cdot PC4(-1) + C(6)\cdot PC1(-2) + C(7)\cdot DUMMYPC1(-1) + C(8)\cdot PC3(-4) + [MA(4)=C(9), BACKCAST=1997Q2] \]

21.9. ARMA PC1 regression

\[ PC1 = C(1) + C(2)\cdot PC1(-1) + C(3)\cdot DUMMYPC1(-1) + [AR(1)=C(4), AR(3)=C(5), MA(3)=C(6), BACKCAST=1997Q2] \]
Table 21.1. GDP Deflator Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP deflator</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>18.06%</td>
<td>20.12%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>PCs</td>
<td>21.1</td>
<td>Full</td>
<td>No</td>
<td>18.19%</td>
<td>19.79%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Consumer pieces</td>
<td>21.2</td>
<td>Full</td>
<td>No</td>
<td>15.89%</td>
<td>16.31%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Industrial producer prices</td>
<td>21.3</td>
<td>Full</td>
<td>Yes</td>
<td>19.54%</td>
<td>19.29%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Nominal ruble/U.S. dollar exchange rate</td>
<td>21.4</td>
<td>Full</td>
<td>No</td>
<td>18.56%</td>
<td>21.58%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>21.5</td>
<td>Full</td>
<td>No</td>
<td>19.18%</td>
<td>21.01%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Nominal M2</td>
<td>21.6</td>
<td>Full</td>
<td>Yes</td>
<td>14.12%</td>
<td>15.69%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>21.7</td>
<td>Full</td>
<td>Yes</td>
<td>14.87%</td>
<td>17.17%</td>
</tr>
</tbody>
</table>
Table 21.2. GDP Deflator Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP deflator</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>20.12%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>PCs</td>
<td>21.8</td>
<td>Full</td>
<td>Yes</td>
<td>No</td>
<td>20.21%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>PCs</td>
<td>21.1</td>
<td>Full</td>
<td>No</td>
<td>Yes</td>
<td>20.24%</td>
</tr>
</tbody>
</table>
Table 21.3. Partial Derivatives of GDP Deflator with Respect to:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural production</td>
<td>0.0017</td>
</tr>
<tr>
<td>Real construction</td>
<td>-0.0006</td>
</tr>
<tr>
<td>Real industrial production</td>
<td>0.0011</td>
</tr>
<tr>
<td>Nominal ruble/U.S. dollar exchange rate</td>
<td>0.0052</td>
</tr>
<tr>
<td>Merchandise imports (in U.S. dollars)</td>
<td>-0.0028</td>
</tr>
<tr>
<td>Nominal M2</td>
<td>0.0063</td>
</tr>
<tr>
<td>Food consumer prices</td>
<td>0.0076</td>
</tr>
<tr>
<td>Non-food product consumer prices</td>
<td>0.0071</td>
</tr>
<tr>
<td>Services consumer prices</td>
<td>0.0065</td>
</tr>
<tr>
<td>Fuel producer prices</td>
<td>0.0035</td>
</tr>
<tr>
<td>Electricity producer prices</td>
<td>0.0046</td>
</tr>
<tr>
<td>Ferrous metallurgy producer prices</td>
<td>0.0058</td>
</tr>
<tr>
<td>Non-ferrous metallurgy producer prices</td>
<td>0.0064</td>
</tr>
<tr>
<td>Chemical industry producer prices</td>
<td>0.0077</td>
</tr>
<tr>
<td>Machine-building producer prices</td>
<td>0.0087</td>
</tr>
<tr>
<td>Food processing industry producer prices</td>
<td>0.0087</td>
</tr>
<tr>
<td>Light industry producer prices</td>
<td>0.0088</td>
</tr>
<tr>
<td>Animal husbandry producer prices</td>
<td>0.0069</td>
</tr>
<tr>
<td>Construction prices</td>
<td>0.0036</td>
</tr>
</tbody>
</table>
22. Other Goods

Variables

The dependent variable: real other goods production value-added, the difference of the logarithms of the year-over-year indices – DLOGVA

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real construction
- Real industrial production
- Real retail sales
- Real inventories in retail sales
- Freight transportation (in ton-kilometers)
- Real per capita consumer spending on goods and services
- Merchandise exports to CIS (in U.S. dollars)
- Merchandise exports outside CIS (in U.S. dollars)
- Merchandise imports from CIS (in U.S. dollars)
- Merchandise imports from outside CIS (in U.S. dollars)
- Employment
- Real average wage
- Real ruble/U.S. dollar exchange rate
- Ratio of consolidated government budget expenditures to revenues
- Ratio of defense spending to consolidated government budget expenditures
- Real M2
- Ratio of consumer prices to industrial producer prices
- Ratio of services consumer prices to total consumer prices
- Brent crude oil spot price (in U.S. dollars)
22.1. Regression of real other goods production value-added on principal components

\[ DLOGVA = C(1) + C(2) \times DLOGVA(-3) + C(3) \times DLOGVA(-4) + C(4) \times PC1 + C(5) \times PC1(-1) + C(6) \times PC11(-1) + C(7) \times PC13(-2) + [MA(4)=C(8),BACKCAST=1997:2] \]

Dependent Variable: DLOGVA  
Method: Least Squares
Sample(adjusted): 1997:2 2004:3  
Included observations: 30 after adjusting endpoints  
Convergence achieved after 10 iterations  
Backcast: 1996:2 1997:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.006650</td>
<td>0.010994</td>
<td>0.604901</td>
<td>0.5514</td>
</tr>
<tr>
<td>DLOGVA(-3)</td>
<td>0.392206</td>
<td>0.081014</td>
<td>4.841243</td>
<td>0.0001</td>
</tr>
<tr>
<td>DLOGVA(-4)</td>
<td>-0.279469</td>
<td>0.072518</td>
<td>-3.853798</td>
<td>0.0009</td>
</tr>
<tr>
<td>PC1</td>
<td>0.026707</td>
<td>0.003958</td>
<td>6.747695</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.023151</td>
<td>0.003455</td>
<td>-6.701080</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC11(-1)</td>
<td>0.017825</td>
<td>0.014225</td>
<td>1.253075</td>
<td>0.2233</td>
</tr>
<tr>
<td>PC13(-2)</td>
<td>-0.049758</td>
<td>0.020925</td>
<td>-2.377997</td>
<td>0.0265</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.972597</td>
<td>0.034415</td>
<td>28.26103</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared            0.865351  Mean dependent var  0.003990
Adjusted R-squared   0.822508  S.D. dependent var  0.079706
S.E. of regression   0.033580  Akaike info criterion -3.726592
Sum squared resid    0.024808  Schwarz criterion -3.352939
Log likelihood       63.89888  F-statistic          20.19819
Durbin-Watson stat   2.375642  Prob(F-statistic)    0.000000

Inverted MA Roots    .70+.70i .70+.70i -.70 -.70i -.70 -.70i
22.2. Regression of real other goods production value-added on principal components (a crisis dummy variable is included)

\[
DLOGVA = C(1) + C(2)DLOGVA(-3) + C(3)DUMMYDLOGVA(-3) + C(4)DLOGVA(-4) + C(5)PC1 + C(6)PC1(-1) + C(7)PC11(-1) + C(8)PC13(-2) + [MA(4)=C(9),BACKCAST=1997:2]
\]

22.3. Regression of real other goods production value-added on Brent crude oil spot price

\[
DLOGVA = C(1) + C(2)DLOGVA(-4) + C(3)DLBRENT + C(4)DUMMYDLBRENT + C(5)DLBRENT(-1) + [AR(1)=C(6),AR(2)=C(7),MA(4)=C(8),BACKCAST=1997Q4]
\]

22.4. Regression of real other goods production value-added on real industrial production

\[
DLOGVA = C(1) + C(2)DLOGVA(-4) + C(3)DLIND(-2) + [AR(1)=C(4),AR(2)=C(5),MA(4)=C(6),BACKCAST=1997:4]
\]

22.5. Regression of real other goods production value-added on real ruble/U.S. dollar exchange rate

\[
DLOGVA = C(1) + C(2)DLOGVA(-1) + C(3)DLOGVA(-4) + C(4)DUMDLREALEXRATE(-1) + [AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997:4]
\]

22.6. Regression of real other goods production value-added on real retail sales

\[
DLOGVA = C(1) + C(2)DUMMY2 + C(3)DLOGVA(-3) + C(4)DLOGVA(-4) + C(5)DRLRETALES(-2) + C(6)DRLRETALES(-4) + C(7)DUMDLRETALES(-4) + [AR(1)=C(8),AR(2)=C(9),MA(4)=C(10),BACKCAST=1997Q4]
\]

22.7. Regression of real other goods production value-added on freight transportation

\[
DLOGVA = C(1) + C(2)DUMMY2 + C(3)DLOGVA(-4) + C(4)DLTRANSPORT + C(5)DLTRANSPORT(-3) + C(6)DLTRANSPORT(-4) + [AR(1)=C(7),AR(2)=C(8),MA(4)=C(9),BACKCAST=1997Q4]
\]

22.8. Regression of real other goods production value-added on real M2

\[
DLOGVA = C(1) + C(2)DUMMY2 + C(3)DLOGVA(-4) + C(4)DUMMYDLREALM2 + C(5)DRLREALM2(-2) + C(6)DUMMYDLREALM2(-2) + [AR(1)=C(7),AR(2)=C(8),MA(4)=C(9),BACKCAST=1997Q4]
\]
22.9. Regression of real other goods production value-added on principal components (no contemporaneous independent variables)

\[ DLOGVA = C(1) + C(2) \times PC1(-1) + C(3) \times PC3(-1) + C(4) \times PC4(-1) + C(5) \times PC1(-2) + \]
\[ \text{AR}(1)=C(6), \text{AR}(2)=C(7), \text{AR}(4)=C(8), \text{MA}(4)=C(9), \text{BACKCAST}=1997Q4 \]

22.10. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \times PC1(-1) + C(3) \times DUMMYPC1(-1) + C(4) \times PC1(-4) + \]
\[ C(5) \times DUMMYPC1(-4) + \text{MA}(6)=C(6), \text{BACKCAST}=1997:2 \]
Table 22.1. Other Goods Production Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other goods production value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.09%</td>
<td>6.09%</td>
<td></td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>22.1</td>
<td>Full</td>
<td>No</td>
<td>6.33%</td>
<td>6.70%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>22.2</td>
<td>Full</td>
<td>Yes</td>
<td>6.90%</td>
<td>7.09%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>Brent crude oil spot price</td>
<td>22.3</td>
<td>Full</td>
<td>Yes</td>
<td>5.25%</td>
<td>8.38%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>22.4</td>
<td>Full</td>
<td>No</td>
<td>9.00%</td>
<td>7.22%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>Real ruble/U.S. dollar exchange rate</td>
<td>22.5</td>
<td>Full</td>
<td>Yes</td>
<td>7.68%</td>
<td>4.10%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>Real retail sales</td>
<td>22.6</td>
<td>Full</td>
<td>Yes</td>
<td>7.76%</td>
<td>5.45%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>Freight transportation</td>
<td>22.7</td>
<td>Full</td>
<td>Yes</td>
<td>8.90%</td>
<td>4.72%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>22.8</td>
<td>Full</td>
<td>Yes</td>
<td>8.69%</td>
<td>3.90%</td>
</tr>
</tbody>
</table>
Table 22.2. Other Goods Production Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Lagged and Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Sample</th>
<th>Crisis dummies</th>
<th>Contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other goods production value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.09%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>22.9</td>
<td>Full</td>
<td>No</td>
<td>No</td>
<td>6.21%</td>
</tr>
<tr>
<td>Real other goods production value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>22.1</td>
<td>Full</td>
<td>No</td>
<td>Yes</td>
<td>4.83%</td>
</tr>
</tbody>
</table>
Appendix B. Armenian Model Regressions and Forecast Summary Tables

Seasonal dummy variables:

DUMMY1 = 1 in the first quarter, = 0 otherwise  
DUMMY2 = 1 in the second quarter, = 0 otherwise  
DUMMY3 = 1 in the third quarter, = 0 otherwise  
DUMMY4 = 1 in the fourth quarter, = 0 otherwise  

1. Real GDP

Variables

The dependent variable: real GDP (RGDP)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real household income
- Real industrial production
- Real dram/U.S. dollar exchange rate
- Real dram/ruble exchange rate
- Real fixed investment
- Real retail trade inventories
- Real retail trade
- Real consumer services
- Freight transportation (in tons-kilometers)
- Real M2
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real commercial bank credit rate
- Ratio of consumer prices to industrial producer prices
- Russian real industrial production

---

61 No more than three of these variables can be used in a regression simultaneously.
### Real GDP Regressions

#### 1.1. Regression of real GDP on principal components

\[
RGDP = C(1) + C(2) \times DUMMY2 + C(3) \times RGDP(-2) + C(4) \times RGDP(-4) + C(5) \times PC1 + C(6) \times PC2 + C(7) \times PC3 + [MA(6)=C(8), BACKCAST=1998Q1]
\]

Dependent Variable: RGDP  
Method: Least Squares

Sample (adjusted): 1998Q1 2004Q3  
Included observations: 27 after adjustments  
Convergence achieved after 21 iterations  
Backcast: 1996Q3 1997Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>246997.6</td>
<td>45863.74</td>
<td>5.385466</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY2</td>
<td>26975.70</td>
<td>6930.340</td>
<td>3.892407</td>
<td>0.0010</td>
</tr>
<tr>
<td>RGDP(-2)</td>
<td>-0.324571</td>
<td>0.062054</td>
<td>-5.230468</td>
<td>0.0000</td>
</tr>
<tr>
<td>RGDP(-4)</td>
<td>0.454999</td>
<td>0.122867</td>
<td>3.703192</td>
<td>0.0015</td>
</tr>
<tr>
<td>PC1</td>
<td>7676.798</td>
<td>1331.450</td>
<td>5.765743</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>-3454.114</td>
<td>965.3553</td>
<td>-3.578075</td>
<td>0.0020</td>
</tr>
<tr>
<td>PC3</td>
<td>2697.029</td>
<td>1511.560</td>
<td>1.784268</td>
<td>0.0904</td>
</tr>
<tr>
<td>MA(6)</td>
<td>-0.978180</td>
<td>0.047153</td>
<td>-20.74477</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.998390  
Adjusted R-squared 0.997796  
S.E. of regression 5883.978  
Akaike info criterion 20.43905  
S.D. dependent var 125346.0  
Schwarz criterion 20.82300  
Log likelihood -267.9272  
F-statistic 1682.883  
Prob(F-statistic) 0.000000

**Inverted MA Roots:**  
\(1.00\) \(0.50 + 0.86i\) \(0.50 - 0.86i\) \(0.50 + 0.86i\) \(0.50 - 0.86i\) \(-1.00\)
1.2. Regression of real GDP on real industrial production

\[ RGDP = C(1) + C(2)*RGDP(-4) + C(3)*RIND + [MA(6)=C(4),BACKCAST=1998:1] \]

1.3. Regression of real GDP on merchandise imports

\[ RGDP = C(1) + C(2)*RGDP(-4) + C(3)*IMP + C(4)*IMP(-1) + C(5)*IMP(-4) + [MA(5)=C(6),BACKCAST=1998:1] \]

1.4. Regression of real GDP on labor income

\[ RGDP = C(1) + C(2)*RGDP(-4) + C(3)*LABINC(-1) + C(4)*LABINC(-2) + [MA(4)=C(5),BACKCAST=1998:1] \]

1.5. Regression of real GDP on government transfers

\[ RGDP = C(1) + C(2)*RGDP(-4) + C(3)*GT(-1) + [MA(6)=C(4),BACKCAST=1998:1] \]

1.6. Regression of real GDP on private transfers

\[ RGDP = C(1) + C(2)*RGDP(-4) + C(3)*PT(-1) + [MA(4)=C(4),BACKCAST=1998Q1] \]

1.7. Regression of real GDP on lagged Russian real GDP

\[ RGDP = C(1) + C(2)*DUMMY4 + C(3)*RGDP(-4) + C(4)*RUSGDP(-4) + [MA(4)=C(5),BACKCAST=1998:1] \]

1.8. PC1 regression

\[ PC1 = C(1) + C(2)*DUMMY1 + C(3)*PC1(-1) + [AR(1)=C(4),MA(2)=C(5),BACKCAST=1997Q3] \]

1.9. PC2 regression

\[ PC2 = C(1) + C(2)*DUMMY1 + C(3)*DUMMY2 + C(4)*DUMMY3 + C(5)*PC2(-2) + C(6)*RUSGDP(-3) + [AR(1)=C(7),MA(5)=C(8),BACKCAST=1998Q1] \]

1.10. PC3 regression

\[ PC3 = C(1) + C(2)*DUMMY1 + C(3)*DUMMY2 + C(4)*DUMMY3 + C(5)*PC3(-1) + C(6)*PC3(-2) + [MA(4)=C(7),BACKCAST=1997:3] \]

1.11. PC1 regression (with contemporaneous Russian real GDP)

\[ PC1 = C(1) + C(2)*DUMMY1 + C(3)*PC1(-1) + C(4)*RUSGDP + [AR(1)=C(5),MA(2)=C(6),BACKCAST=1997:3] \]
1.12. PC2 regression (with contemporaneous Russian real GDP)

\[
PC2 = C(1) + C(2)*DUMMY1 + C(3)*DUMMY2 + C(4)*DUMMY3 + C(5)*PC2(-2) + C(6)*RUSGDP + [MA(5)=C(7),BACKCAST=1997:3]
\]
Table 1.1. GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>10.21%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.1</td>
<td>No</td>
<td>10.49%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>1.2</td>
<td>N/A</td>
<td>14.29%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>1.3</td>
<td>N/A</td>
<td>12.17%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Labor income</td>
<td>1.4</td>
<td>N/A</td>
<td>9.13%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>1.5</td>
<td>N/A</td>
<td>11.50%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>1.6</td>
<td>N/A</td>
<td>9.08%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>1.7</td>
<td>N/A</td>
<td>11.43%</td>
</tr>
</tbody>
</table>

2004 III

| 11.41% |
| 11.56% |
| 13.10% |
| 12.50% |
| 12.74% |
| 14.55% |
| 15.32% |
| 12.99% |
Table 1.2. GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.41%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.1</td>
<td>No</td>
<td>No</td>
<td>11.68%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.1</td>
<td>No</td>
<td>Yes</td>
<td>14.29%</td>
</tr>
</tbody>
</table>
Table 1.3. Partial Derivatives of GDP with Respect to:

<table>
<thead>
<tr>
<th>Economic Indicator</th>
<th>Partial Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural production</td>
<td>1542</td>
</tr>
<tr>
<td>Real household income</td>
<td>2468</td>
</tr>
<tr>
<td>Real industrial production</td>
<td>2267</td>
</tr>
<tr>
<td>Real dram/U.S. dollar exchange rate</td>
<td>10</td>
</tr>
<tr>
<td>Real dram/ruble exchange rate</td>
<td>1615</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>2452</td>
</tr>
<tr>
<td>Real retail trade inventories</td>
<td>830</td>
</tr>
<tr>
<td>Real retail trade</td>
<td>2577</td>
</tr>
<tr>
<td>Real consumer services</td>
<td>2756</td>
</tr>
<tr>
<td>Freight transportation (in tons-kilometers)</td>
<td>1278</td>
</tr>
<tr>
<td>Real M2</td>
<td>1255</td>
</tr>
<tr>
<td>Merchandise exports (in U.S. dollars)</td>
<td>1661</td>
</tr>
<tr>
<td>Merchandise imports (in U.S. dollars)</td>
<td>2490</td>
</tr>
<tr>
<td>Real commercial bank deposit rate</td>
<td>-1272</td>
</tr>
<tr>
<td>Ratio of consumer prices to industrial producer prices</td>
<td>-968</td>
</tr>
<tr>
<td>Russian real industrial production</td>
<td>1477</td>
</tr>
</tbody>
</table>
2. Industry

Variables

The dependent variable: real industrial value-added (RINDVA)

The special variable: real industrial production (RIND)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Ratio of industrial producer prices to freight transportation prices
- Ratio of consumer prices to industrial producer prices
- Real commercial bank credit rate
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real M2
- Real consumer services
- Real retail trade
- Dwellings completed (in square meters)
- Real fixed investment
- Real dram/U.S. dollar exchange rate
- Real dram/U.S. dollar exchange rate
- Real household income
- Electricity production (in physical units)
- Freight transportation (in tons-kilometers)
- Real agricultural production
Industrial value-added regressions

2.1. Regression of real industrial value-added on real industrial production and principal components

\[ RINDVA = C(1) + C(2) \cdot RINDVA(-4) + C(3) \cdot RIND + C(4) \cdot RIND(-1) + C(5) \cdot PC2 + C(6) \cdot PC4 + C(7) \cdot PC6 + [AR(1)=C(8), MA(6)=C(9), BACKCAST=1998Q2] \]

Dependent Variable: RINDVA
Method: Least Squares

Sample (adjusted): 1998Q2 2004Q3
Included observations: 26 after adjustments
Convergence achieved after 18 iterations
Backcast: 1996Q4 1998Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-13899.63</td>
<td>4450.840</td>
<td>-3.122922</td>
<td>0.0062</td>
</tr>
<tr>
<td>RINDVA(-4)</td>
<td>0.629113</td>
<td>0.048180</td>
<td>13.05757</td>
<td>0.0000</td>
</tr>
<tr>
<td>RIND</td>
<td>1170.807</td>
<td>118.0534</td>
<td>9.917602</td>
<td>0.0000</td>
</tr>
<tr>
<td>RIND(-1)</td>
<td>-674.3668</td>
<td>69.98720</td>
<td>-9.635574</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>1158.520</td>
<td>208.4681</td>
<td>5.557300</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC4</td>
<td>1109.665</td>
<td>212.4322</td>
<td>5.223619</td>
<td>0.0001</td>
</tr>
<tr>
<td>PC6</td>
<td>-1051.861</td>
<td>191.4844</td>
<td>-5.493196</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.272287</td>
<td>0.217738</td>
<td>-1.250524</td>
<td>0.2280</td>
</tr>
<tr>
<td>MA(6)</td>
<td>-0.956982</td>
<td>0.031159</td>
<td>-30.71261</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.995158  Mean dependent var 60020.70
Adjusted R-squared 0.992880  S.D. dependent var 16443.38
S.E. of regression 1387.513  Akaike info criterion 17.57584
Sum squared resid 32728251  Schwarz criterion 18.01133
Log likelihood -219.4859  F-statistic 436.7675
Durbin-Watson stat 2.063627  Prob(F-statistic) 0.000000

Inverted AR Roots -.27
Inverted MA Roots .99 .50+.86i .50-.86i -.50+.86i -.50-.86i -.99
2.2. Regression of real industrial value-added on real industrial production

\[ RINDVA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)DUMMY3 + C(5)RIND + C(6)RIND(-1) + C(7)RIND(-2) + [MA(6)=C(8),BACKCAST=1997Q3] \]

2.3. Regression of real industrial value-added on labor income

\[ RINDVA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)DUMMY3 + C(5)LABINC(-3) + C(6)LABINC(-4) + [AR(1)=C(7),AR(3)=C(8),MA(5)=C(9),BACKCAST=1998Q4] \]

2.4. Regression of real industrial value-added on government transfers

\[ RINDVA = C(1) + C(2)DUMMY1 + C(3)DUMMY3 + C(4)GT(-1) + C(5)GT(-2) + C(6)GT(-4) + [AR(1)=C(7),MA(6)=C(8),BACKCAST=1998Q2] \]

2.5. Regression of real industrial value-added on private transfers

\[ RINDVA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)DUMMY3 + C(5)PT(-3) + C(6)PT(-4) + [AR(1)=C(7),MA(4)=C(8),BACKCAST=1998Q2] \]

2.6. Regression of real industrial value-added on lagged Russian real GDP

\[ RINDVA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)DUMMY3 + C(5)RUSGDP(-4) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1998Q2] \]

2.7. Real industrial production regression

\[ RIND = C(1) + C(2)DUMMY1 + C(3)DUMMY3 + C(4)RIND(-1) + C(5)GT(-4) + C(6)RUSGDP(-1) + [MA(4)=C(7),BACKCAST=1998Q1] \]

2.8. PC2 regression

\[ PC2 = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)DUMMY3 + C(5)PC2(-1) + C(6)PC2(-3) + [MA(5)=C(6),MA(7)=C(8),BACKCAST=1997Q2] \]

2.9. PC4 regression

\[ PC4 = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)PC4(-1) + C(5)PC4(-3) + [MA(4)=C(6),MA(5)=C(7),MA(6)=C(8),BACKCAST=1997Q4] \]

2.10. PC6 regression

\[ PC6 = C(1) + C(2)DUMMY1 + C(3)DUMMY3 + C(4)PC6(-1) + C(5)PC6(-2) + C(6)PC6(-4) + [MA(4)=C(7),MA(5)=C(8),MA(6)=C(9),BACKCAST=1998Q1] \]
2.11. PC4 regression (contemporaneous Russian real GDP included)

\[ PC4 = C(1) + C(2) \times DUMMY1 + C(3) \times DUMMY2 + C(4) \times PC4(-1) + C(5) \times PC4(-3) + C(6) \times RUSGDP + [MA(4)=C(7), MA(5)=C(8), MA(6)=C(9), BACKCAST=1997Q4] \]
Table 2.1. Industrial Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real industrial value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.35%</td>
<td>-2.15%</td>
</tr>
<tr>
<td>Real industrial production</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.60%</td>
<td>1.07%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.1</td>
<td>No</td>
<td>5.26%</td>
<td>-2.11%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>2.2</td>
<td>N/A</td>
<td>13.13%</td>
<td>-4.47%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Labor income</td>
<td>2.3</td>
<td>N/A</td>
<td>5.17%</td>
<td>-5.78%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>2.4</td>
<td>N/A</td>
<td>8.18%</td>
<td>7.31%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>2.5</td>
<td>N/A</td>
<td>-0.82%</td>
<td>-1.98%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>2.6</td>
<td>N/A</td>
<td>-3.62%</td>
<td>-2.80%</td>
</tr>
</tbody>
</table>
Table 2.2. Industrial Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real industrial value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-2.15%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.1</td>
<td>No</td>
<td>No</td>
<td>-2.15%</td>
</tr>
<tr>
<td>Real industrial value-added</td>
<td>Forecast</td>
<td>Real industrial production and PCs</td>
<td>2.1</td>
<td>No</td>
<td>Yes</td>
<td>-0.74%</td>
</tr>
</tbody>
</table>
3.2. Construction

Variables

The dependent variable: real construction value-added (RCONSTRVA)

The special variable: real construction activity (RCONSTR)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real consumer services
- Dwellings completed (square meters)
- Real industrial production
- Freight transportation (tons-kilometers)
- Real household income
- Real U.S. dollar/dram exchange rate
- Real rouble/dram exchange rate
- Real M2
- Merchandise exports (U.S. dollars)
- Merchandise imports (U.S. dollars)
- Real commercial bank credit rate
- Ratio of industrial producer prices to construction prices
- Ratio of freight transportation prices to construction prices
- Ratio of consumer prices to construction prices
Real Construction Value-Added Regressions

3.1. Regression of real construction value-added on real construction and principal components

\[ R\text{CONSTRVA} = C(1) + C(2)*DUMMY3 + C(3)*R\text{CONSTR} + C(4)*R\text{CONSTR}(-3) + C(5)*R\text{CONSTR}(-4) + C(6)*PC9 + C(7)*PC1(-1) + C(8)*PC1(-3) + C(9)*PC9(-4) \]

Dependent Variable: RCONSTRVA
Method: Least Squares

Sample (adjusted): 1998Q1 2004Q3
Included observations: 27 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-1319.709</td>
<td>1609.778</td>
<td>-0.819808</td>
<td>0.4230</td>
</tr>
<tr>
<td>DUMMY3</td>
<td>8433.949</td>
<td>836.6719</td>
<td>10.08035</td>
<td>0.0000</td>
</tr>
<tr>
<td>RCONSTR</td>
<td>1.224596</td>
<td>0.053120</td>
<td>23.05346</td>
<td>0.0000</td>
</tr>
<tr>
<td>RCONSTR(-3)</td>
<td>-0.170679</td>
<td>0.050940</td>
<td>-3.350567</td>
<td>0.0036</td>
</tr>
<tr>
<td>RCONSTR(-4)</td>
<td>0.195750</td>
<td>0.065472</td>
<td>2.989808</td>
<td>0.0079</td>
</tr>
<tr>
<td>PC9</td>
<td>512.8831</td>
<td>285.6528</td>
<td>1.795477</td>
<td>0.0894</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-448.9398</td>
<td>85.14260</td>
<td>-5.272799</td>
<td>0.0001</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>433.5212</td>
<td>172.9436</td>
<td>2.506719</td>
<td>0.0220</td>
</tr>
<tr>
<td>PC9(-4)</td>
<td>403.7563</td>
<td>294.9354</td>
<td>1.368965</td>
<td>0.1879</td>
</tr>
</tbody>
</table>

R-squared  0.997925  Mean dependent var 33924.81
Adjusted R-squared  0.997003  S.D. dependent var 26404.29
S.E. of regression 1445.474  Akaike info criterion 17.65146
Sum squared resid  37609124  Schwarz criterion 18.08341
Log likelihood -229.2948  F-statistic  1082.206
Durbin-Watson stat 2.294123  Prob(F-statistic) 0.000000
3.2. Regression of real construction value-added on real construction

\[ R\text{CONSTRVA} = C(1) + C(2)\ast DUMMY2 + C(3)\ast DUMMY3 + C(4)\ast R\text{CONSTR} + C(5)\ast R\text{CONSTR}(-3) + C(6)\ast R\text{CONSTR}(-4) \]

3.3. Regression of real construction value-added on real construction (the sample starts in 1998Q1 before adjustment)

\[ R\text{CONSTRVA} = C(1) + C(2)\ast DUMMY3 + C(3)\ast R\text{CONSTR} + C(4)\ast R\text{CONSTR}(-3) + C(5)\ast R\text{CONSTR}(-4) \]

3.4. Regression of real construction value-added on real industrial production

\[ R\text{CONSTRVA} = C(1) + C(2)\ast R\text{CONSTRVA}(-4) + C(3)\ast R\text{IND} + C(4)\ast R\text{IND}(-4) \]

3.5. Regression of construction value-added on government transfers

\[ R\text{CONSTRVA} = C(1) + C(2)\ast R\text{CONSTRVA}(-4) + C(3)\ast GT(-1) + C(4)\ast GT(-2) + \{AR(1)=C(5),MA(4)=C(6),BACKCAST=1998:2\} \]

3.6. Regression of construction industrial value-added on private transfers

\[ R\text{CONSTRVA} = C(1) + C(2)\ast R\text{CONSTRVA}(-4) + C(3)\ast PT(-2) + C(4)\ast PT(-4) + \{AR(1)=C(5),MA(4)=C(6),BACKCAST=1998Q2\} \]

3.7. Regression of construction industrial value-added on Russian real GDP

\[ R\text{CONSTRVA} = C(1) + C(2)\ast R\text{CONSTRVA}(-4) + C(3)\ast R\text{USGDP}(-4) + \{AR(1)=C(4),MA(4)=C(5),BACKCAST=1998Q2\} \]

3.8. Real construction regression

\[ R\text{CONSTR} = C(1) + C(2)\ast DUMMY4 + C(3)\ast R\text{CONSTR}(-2) + C(4)\ast GT(-1) + C(5)\ast GT(-4) + C(6)\ast PT(-4) + \{AR(1)=C(7),MA(4)=C(8),BACKCAST=1998Q2\} \]

3.9. PC9 regression

\[ PC9 = C(1) + C(2)\ast PC9(-2) + C(3)\ast PC9(-3) + C(4)\ast GT(-2) + C(5)\ast PT(-1) + C(6)\ast PT(-2) + \{MA(4)=C(7),BACKCAST=1997Q4\} \]
Table 3.1. Construction Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real construction value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.94%</td>
<td>14.53%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.69%</td>
<td>15.92%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction and PCs</td>
<td>3.1</td>
<td>No</td>
<td>7.97%</td>
<td>15.46%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction</td>
<td>3.2</td>
<td>N/A</td>
<td>15.18%</td>
<td>16.99%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction</td>
<td>3.3</td>
<td>N/A</td>
<td>10.79%</td>
<td>15.45%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>3.4</td>
<td>N/A</td>
<td>38.83%</td>
<td>27.22%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>3.5</td>
<td>N/A</td>
<td>34.53%</td>
<td>35.02%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>3.6</td>
<td>N/A</td>
<td>38.85%</td>
<td>27.36%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>3.7</td>
<td>N/A</td>
<td>25.20%</td>
<td>35.50%</td>
</tr>
</tbody>
</table>
Table 3.2. Construction Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real construction value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>14.53%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction and PCs</td>
<td>3.1</td>
<td>No</td>
<td>No</td>
<td>14.79%</td>
</tr>
</tbody>
</table>
4. Agriculture

Variables

The dependent variable: real agricultural value-added (RAGRVA)

The special variable: real agricultural production (RAGR)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real household income
- Real consumer spending on goods and services
- Real dram/U.S. dollar exchange rate
- Real dram/ruble exchange rate
- Real industrial production
- Real fixed investment
- Real retail trade
- Real M2
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real commercial bank credit rate
- Freight transportation
- Ratio of agricultural producer prices to consumer prices
- Ratio of agricultural producer prices to industrial producer prices
### Agricultural Value-Added Regressions

#### 4.1. Regression of real agricultural value-added on real agricultural production, current transfers, lagged Russian real GDP, and principal components

\[
RAGRVA = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot RAGR + C(6) \cdot PC1 + C(7) \cdot PC9 + C(8) \cdot PT(-1) + C(9) \cdot RUSGDP(-3) + [AR(1)=C(10)]
\]

Dependent Variable: RAGRVA  
Method: Least Squares  
Sample (adjusted): 1998Q1 2004Q3  
Included observations: 27 after adjustments  
Convergence achieved after 9 iterations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>101536.3</td>
<td>18141.79</td>
<td>5.596816</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY1</td>
<td>-51516.91</td>
<td>8642.816</td>
<td>-5.960662</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY2</td>
<td>-13237.99</td>
<td>7936.708</td>
<td>-1.667945</td>
<td>0.1136</td>
</tr>
<tr>
<td>DUMMY3</td>
<td>49944.30</td>
<td>5466.786</td>
<td>9.135954</td>
<td>0.0000</td>
</tr>
<tr>
<td>RAGR</td>
<td>110.2771</td>
<td>62.10451</td>
<td>1.775669</td>
<td>0.0937</td>
</tr>
<tr>
<td>PC1</td>
<td>-927.7238</td>
<td>329.8850</td>
<td>-2.812264</td>
<td>0.0120</td>
</tr>
<tr>
<td>PC9</td>
<td>-6194.086</td>
<td>1518.410</td>
<td>-4.079324</td>
<td>0.0008</td>
</tr>
<tr>
<td>PT(-1)</td>
<td>645.3391</td>
<td>138.5000</td>
<td>4.659489</td>
<td>0.0002</td>
</tr>
<tr>
<td>RUSGDP(-3)</td>
<td>-429.8538</td>
<td>206.4466</td>
<td>-2.082155</td>
<td>0.0527</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.489482</td>
<td>0.218311</td>
<td>-2.242132</td>
<td>0.0386</td>
</tr>
</tbody>
</table>

- R-squared 0.993158  
- Mean dependent var 81459.73  
- Adjusted R-squared 0.989536  
- S.D. dependent var 50079.80  
- S.E. of regression 5122.804  
- Akaike info criterion 20.19891  
- Sum squared resid 4.46E+08  
- Schwarz criterion 20.67885  
- Log likelihood -262.6853  
- F-statistic 274.1947  
- Durbin-Watson stat 2.231567  
- Prob(F-statistic) 0.000000  

| Inverted AR Roots | -.49 |
4.2. Regression of real agricultural value-added on real agricultural production

\[ RAGRVA = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times RAGR \\
+ C(6)\times RAGR(-2) + [AR(1)=C(7),MA(4)=C(8),BACKCAST=1997Q4] \]

4.3. Regression of real agricultural value-added on labor income

\[ RAGRVA = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times LABINC(-1) + C(6)\times LABINC(-3) + [AR(1)=C(7),AR(3)=C(8)] \]

4.4. Regression of real agricultural value-added on government transfers

\[ RAGRVA = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times GT(-1) + [MA(5)=C(6),BACKCAST=1997Q2] \]

4.5. Regression of real industrial value-added on private transfers

\[ RAGRVA = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times PT(-1) + [AR(4)=C(6),MA(5)=C(7),BACKCAST=1998Q2] \]

4.6. Regression of real agricultural value-added on lagged Russian real GDP

\[ RAGRVA = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times RUSGDP(-2) + C(6)\times RUSGDP(-3) + C(7)\times RUSGDP(-4) + [AR(4)=C(7),MA(6)=C(8),BACKCAST=1999Q1] \]

4.7. Regression of real agricultural value-added on real agricultural production, current transfers, contemporaneous and lagged Russian real GDP, and principal components

\[ RAGRVA = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times DUMMY3 + C(5)\times RAGR + C(6)\times PC9 + C(7)\times PT(-1) + C(8)\times RUSGDP + C(9)\times RUSGDP(-3) + [AR(1)=C(10)] \]

4.8. Real agricultural production regression

\[ RAGR = C(1) + C(2)\times DUMMY1 + C(3)\times DUMMY2 + C(4)\times LABINC(-5) + C(5)\times LABINC(-6) + C(6)\times RCAPEXP(-5) + [MA(1)=C(7),MA(7)=C(8),BACKCAST=1998Q3] \]

4.9. PC1 regression

\[ PC1 = C(1) + C(2)\times DUMMY1 + C(3)\times PC1(-1) + [MA(4)=C(4),BACKCAST=1997Q2] \]

4.10. PC9 regression

\[ PC9 = C(1) + C(2)\times PC9(-2) + C(3)\times PC9(-3) + C(4)\times LABINC(-2) + C(5)\times PT(-1) + [AR(1)=C(6),AR(3)=C(7),MA(4)=C(8),BACKCAST=1998Q3] \]
4.11. PC1 regression (contemporaneous Russian real GDP included)

\[ PC1 = C(1) + C(2)\times DUMMY1 + C(3)\times PC1(-1) + C(4)\times RUSGDP + [MA(4)=C(5), BACKCAST=1997Q2] \]
Table 4.1. Agricultural Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>8.95%</td>
<td>21.51%</td>
</tr>
<tr>
<td>Real agricultural production</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.38%</td>
<td>24.08%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Real agricultural production and PCs</td>
<td>4.1</td>
<td>No</td>
<td>9.64%</td>
<td>20.93%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Real agricultural production, quarterly variables, and PCs</td>
<td>4.2</td>
<td>N/A</td>
<td>4.07%</td>
<td>3.52%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Labor income</td>
<td>4.3</td>
<td>N/A</td>
<td>-11.48%</td>
<td>0.79%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>4.4</td>
<td>N/A</td>
<td>-13.42%</td>
<td>-8.09%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>4.5</td>
<td>N/A</td>
<td>10.23%</td>
<td>10.54%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>4.6</td>
<td>N/A</td>
<td>8.97%</td>
<td>3.25%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Real agricultural production, quarterly variables, and PCs</td>
<td>4.7</td>
<td>Yes</td>
<td>13.70%</td>
<td>24.15%</td>
</tr>
</tbody>
</table>
Table 4.2. Agricultural Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real agricultural value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>21.51%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Real agricultural production, quarterly variables, and PCs</td>
<td>4.1</td>
<td>No</td>
<td>No</td>
<td>21.73%</td>
</tr>
<tr>
<td>Real agricultural value-added</td>
<td>Forecast</td>
<td>Real agricultural production, quarterly variables, and PCs</td>
<td>4.1</td>
<td>No</td>
<td>Yes</td>
<td>22.50%</td>
</tr>
</tbody>
</table>
5. Trade

Variables

The dependent variable: real trade value-added (RTRADEVA)

The special variable: real retail trade (RTRADE)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real commercial bank credit rate
- Real industrial production
- Real household income
- Real retail trade inventories
- Real fixed investment
- Real dram/U.S. dollar exchange rate
- Real dram/ruble exchange rate
- Dwellings completed (in square meters)
- Real consumer services
- Real M2
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Ratio of consumer prices to industrial producer prices
- Freight transportation (in ton-kilometers)
### Real Trade Value-Added Regressions

#### 5.1. Regression of real trade value-added on principal components (no contemporaneous independent variables)

\[
\text{RTRADEVA} = C(1) + C(2)\text{DUMMY1} + C(3)\text{DUMMY2} + C(4)\text{DUMMY3} + C(5)\text{PC1(-1)} + C(6)\text{PC1(-4)} + \{\text{MA(4)}=C(7),\text{BACKCAST}=1998Q1\}
\]

Dependent Variable: RTRADEVA  
Method: Least Squares  

Sample (adjusted): 1998Q1 2004Q3  
Included observations: 27 after adjustments  
Convergence achieved after 11 iterations  
Backcast: 1997Q1 1997Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>51507.89</td>
<td>1848.175</td>
<td>27.86959</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY1</td>
<td>-28701.51</td>
<td>3331.252</td>
<td>-8.615831</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY2</td>
<td>-31917.16</td>
<td>2578.450</td>
<td>-12.37843</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY3</td>
<td>-22860.81</td>
<td>2479.800</td>
<td>-9.218811</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>664.0859</td>
<td>216.6234</td>
<td>3.065623</td>
<td>0.0061</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>352.9924</td>
<td>209.0613</td>
<td>1.688463</td>
<td>0.1069</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.905312</td>
<td>0.062426</td>
<td>14.50209</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.982787  
Adjusted R-squared: 0.977623  
S.E. of regression: 2328.819  
Akaike info criterion: 18.56252  
Schwarz criterion: 18.89848  
Log likelihood: -243.5941  
F-statistic: 190.3166  
Durbin-Watson stat: 2.013761  
Prob(F-statistic): 0.000000

Inverted MA Roots: .69+.69i, .69-.69i, -.69-.69i, -.69+.69i
Table 5.1. Trade Value-Added Growth Rates. Official Figure and One-Quarter-Ahead Out-of-Sample Forecast

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real trade value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>8.46%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>5.1</td>
<td>No</td>
<td>N/A</td>
<td>7.80%</td>
</tr>
</tbody>
</table>
6. Transportation

Variables

The dependent variable: real transportation and communication value-added (RTRANSPVA)

Real Transportation Value-Added Regressions

6.1. ARMA real transportation value-added regression

\[ RTRANSPVA = C(1) + C(2) \times DUMMY2 + C(3) \times RTRANSPVA(-2) + \]

Dependent Variable: RTRANSPVA
Method: Least Squares

Sample (adjusted): 1997Q4 2004Q3
Included observations: 28 after adjustments
Convergence achieved after 13 iterations
Backcast: 1996Q4 1997Q3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>46953.79</td>
<td>8567.924</td>
<td>5.480184</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY2</td>
<td>6880.807</td>
<td>1495.494</td>
<td>4.601026</td>
<td>0.0001</td>
</tr>
<tr>
<td>RTRANSPVA(-2)</td>
<td>-1.221373</td>
<td>0.070638</td>
<td>-17.29056</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.886317</td>
<td>0.095514</td>
<td>9.279484</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>0.930314</td>
<td>0.040920</td>
<td>22.73488</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.971695
Mean dependent var 18560.48

Adjusted R-squared 0.966772
S.D. dependent var 10721.12

S.E. of regression 87844177
Akaike info criterion 1954.306

Sum squared resid 87844177
Schwarz criterion 18.39178

Log likelihood -249.1545
F-statistic 197.3916

Durbin-Watson stat 2.127275
Prob(F-statistic) 0.000000

Inverted AR Roots .89
Inverted MA Roots .69+.69i .69+.69i -.69-.69i -.69-.69i
6.2. Regression of real transportation value-added on freight transportation (in ton-kilometers)

\[ RTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot RTRANSPVA(-2) + C(4) \cdot TRANSP + \]
\[ AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q4 \]

6.3. Regression of real transportation value-added on labor income

\[ RTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot RTRANSPVA(-2) + C(4) \cdot LABINC(-3) + \]
\[ AR(1)=C(5), MA(4)=C(6), BACKCAST=1998Q1 \]

6.4. Regression of real transportation value-added on government transfers

\[ RTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot RTRANSPVA(-2) + C(4) \cdot GT(-3) + \]
\[ AR(1)=C(5), MA(5)=C(6), BACKCAST=1998Q1 \]

6.5. Regression of real transportation value-added on private transfers

\[ RTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot RTRANSPVA(-2) + C(4) \cdot PT(-1) + \]
\[ AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q4 \]

6.6. Regression of real transportation value-added on lagged Russian real GDP

\[ RTRANSPVA = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot RTRANSPVA(-2) + C(4) \cdot RUSGDP(-1) + \]
\[ AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q4 \]

6.7. Regression of real transportation value-added on contemporaneous Russian real GDP

\[ RTRANSPVA = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot RTRANSPVA(-2) + C(4) \cdot RUSGDP + \]
\[ AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q4 \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real transportation value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>15.59%</td>
<td>18.89%</td>
</tr>
<tr>
<td>Freight transportation</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.09%</td>
<td>43.52%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>ARMA</td>
<td>6.1</td>
<td>No</td>
<td>15.49%</td>
<td>19.76%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Freight transportation</td>
<td>6.2</td>
<td>N/A</td>
<td>12.59%</td>
<td>19.87%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Labor income</td>
<td>6.3</td>
<td>N/A</td>
<td>24.34%</td>
<td>23.13%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>6.4</td>
<td>N/A</td>
<td>-6.76%</td>
<td>6.22%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>6.5</td>
<td>N/A</td>
<td>3.49%</td>
<td>34.35%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>6.6</td>
<td>N/A</td>
<td>8.17%</td>
<td>7.06%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>ARMA</td>
<td>6.7</td>
<td>Yes</td>
<td>13.47%</td>
<td>19.47%</td>
</tr>
</tbody>
</table>
Table 6.2. Transportation Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables (the sample is reduced by one quarter)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real transportation value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>18.89%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>ARMA</td>
<td>6.1</td>
<td>No</td>
<td>No</td>
<td>20.15%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>ARMA</td>
<td>6.7</td>
<td>Yes</td>
<td>No</td>
<td>20.62%</td>
</tr>
</tbody>
</table>
7. Other Services

Variables

The dependent variable: real other services value-added (ROTHVA)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real agricultural production
- Real consumer spending on goods and services
- Real U.S. dollar/dram exchange rate
- Real ruble/dram exchange rate
- Real industrial production
- Real fixed investment
- Real retail trade
- Real retail trade inventories
- Real paid consumer services
- Real M2
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real commercial bank deposit rate
- Freight transportation (in tons-kilometers)
- Ratio of consumer services prices to consumer goods prices
- Ratio of consumer services prices to industrial producer prices
7.1. Regression of real other services value-added on principal components

\[ ROTHVA = C(1) + C(2) \times DUMMY2 + C(3) \times ROTHVA(-4) + C(4) \times PC1 + C(5) \times PC4(-1) + C(6) \times PC2(-4) + [AR(1)=C(7),AR(2)=C(8),MA(2)=C(9),BACKCAST=1998:3] \]

Dependent Variable: ROTHVA
Method: Least Squares

Sample(adjusted): 1998:3 2004:3
Included observations: 25 after adjusting endpoints
Convergence achieved after 11 iterations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>12278.57</td>
<td>2634.586</td>
<td>4.660532</td>
<td>0.0003</td>
</tr>
<tr>
<td>DUMMY2</td>
<td>6437.117</td>
<td>1937.225</td>
<td>3.322855</td>
<td>0.0043</td>
</tr>
<tr>
<td>ROTHVA(-4)</td>
<td>0.751532</td>
<td>0.070172</td>
<td>10.70979</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-546.2418</td>
<td>51.63916</td>
<td>-10.57805</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC4(-1)</td>
<td>904.2939</td>
<td>356.9949</td>
<td>2.533072</td>
<td>0.0221</td>
</tr>
<tr>
<td>PC2(-4)</td>
<td>-264.9711</td>
<td>75.02472</td>
<td>-3.531784</td>
<td>0.0028</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.841214</td>
<td>0.235912</td>
<td>-3.565802</td>
<td>0.0026</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.405750</td>
<td>0.197580</td>
<td>-2.053598</td>
<td>0.0567</td>
</tr>
<tr>
<td>MA(2)</td>
<td>-0.994988</td>
<td>0.058759</td>
<td>-16.93330</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.987766  Mean dependent var  46834.52
Adjusted R-squared 0.981649  S.D. dependent var  15307.79
S.E. of regression 2073.695  Akaike info criterion  18.38576
Sum squared resid 68803386  Schwarz criterion  18.82456
Log likelihood -220.8221  F-statistic  161.4769
Durbin-Watson stat 1.801669  Prob(F-statistic)  0.000000

Inverted AR Roots -.42 -.48i  -.42+.48i
Inverted MA Roots 1.00 -1.00
7.2. Regression of real other services value-added on real consumer spending on goods and services

$$ROTHVA = C(1) + C(2)*DUMMY2 + C(3)*ROTHVA(-4) + C(4)*RSPENGS + [AR(1)=C(5),MA(2)=C(6),BACKCAST=1998:2]$$

7.3. Regression of real other services value-added on real consumer services

$$ROTHVA = C(1) + C(2)*DUMMY2 + C(3)*ROTHVA(-4) + C(4)*RSERV + [AR(1)=C(5),MA(2)=C(6),BACKCAST=1998:2]$$

7.4. Regression of real other services value-added on labor income

$$ROTHVA = C(1) + C(2)*DUMMY4 + C(3)*ROTHVA(-4) + C(4)*LABINC(-1) + [AR(1)=C(5),MA(2)=C(6),BACKCAST=1998:2]$$

7.5. Regression of real other services value-added on government transfers

$$ROTHVA = C(1) + C(2)*DUMMY1 + C(3)*ROTHVA(-4) + C(4)*GT(-4) + [AR(1)=C(5),MA(2)=C(6),BACKCAST=1998:2]$$

7.6. Regression of real other services value-added on private transfers

$$ROTHVA = C(1) + C(2)*ROTHVA(-4) + C(3)*PT(-4) + [AR(1)=C(4),MA(4)=C(5),BACKCAST=1998:2]$$

7.7. Regression of real other services value-added on lagged Russian real GDP

$$ROTHVA = C(1) + C(2)*DUMMY3 + C(3)*ROTHVA(-4) + C(4)*RUSGDP(-4) + [AR(1)=C(5),MA(2)=C(6),BACKCAST=1998:2]$$

7.8. PC1 regression

$$PC1 = C(1) + C(2)*DUMMY1 + C(3)*DUMMY3 + C(4)*PC1(-1) + C(5)*PC1(-4) + C(6)*GT(-1) + C(7)*GT(-3) + [AR(1)=C(8),AR(2)=C(9),AR(3)=C(10)]$$
Table 7.1. Other Services Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other services value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>22.76%</td>
<td>4.34%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>7.1</td>
<td>No</td>
<td>22.65%</td>
<td>5.91%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>Real consumer spending on goods and services</td>
<td>7.2</td>
<td>N/A</td>
<td>12.22%</td>
<td>5.84%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>Real paid consumer services</td>
<td>7.3</td>
<td>N/A</td>
<td>17.05%</td>
<td>3.92%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>Labor income</td>
<td>7.4</td>
<td>N/A</td>
<td>9.90%</td>
<td>19.09%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>7.5</td>
<td>N/A</td>
<td>12.62%</td>
<td>5.94%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>7.6</td>
<td>N/A</td>
<td>14.02%</td>
<td>14.74%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>7.7</td>
<td>N/A</td>
<td>12.43%</td>
<td>11.37%</td>
</tr>
</tbody>
</table>
Table 7.2. Other Services Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other services value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.34%</td>
</tr>
<tr>
<td>Real other services value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>7.1</td>
<td>No</td>
<td>No</td>
<td>4.94%</td>
</tr>
</tbody>
</table>
8. Taxes

Variables

The dependent variable: real net taxes on products and imports (RTAXPI)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Ratio of consumer prices to industrial producer prices
- Real fixed investment
- Real household income
- Real household spending on goods and services
- Real U.S. dollar/dram exchange rate
- Real ruble/dram exchange rate
- Real agricultural production
- Real industrial production
- Freight transportation (in tons-kilometers)
- Real retail trade
- Real retail trade inventories
- Real consumer services
- Real M2
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
Regressions of Net Taxes

8.1. Regression of real net taxes on products and imports on principal components, real VAT, real excise taxes, and real Russian GDP

\[ RTAXPI = C(1) + C(2) \cdot PC1 + C(3) \cdot PC1(-3) + C(4) \cdot PC6(-4) + C(5) \cdot RVAT(-1) + C(6) \cdot REXTAX(-3) + C(7) \cdot RUSGDP(-4) + \]
\[ AR(4)=C(8), MA(4)=C(9), BACKCAST=1999Q1 \]

8.2. Regression of real net taxes on products and imports on real industrial production

\[ RTAXPI = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot RIND \]
\[ AR(1)=C(6), MA(4)=C(7), BACKCAST=1997Q2 \]

8.3. Regression of real net taxes on products and imports on real VAT

\[ RTAXPI = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot RTAXPI(-3) + C(4) \cdot RVAT + C(5) \cdot RVAT(-1) \]
\[ MA(6)=C(6), BACKCAST=1997Q4 \]

8.4. Regression of real net taxes on products and imports on labor income

\[ RTAXPI = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot LABINC(-1) + C(6) \cdot LABINC(-4) \]
\[ AR(1)=C(7), AR(4)=C(8), MA(4)=C(9), BACKCAST=1999Q1 \]

8.5. Regression of real net taxes on products and imports on government transfers

\[ RTAXPI = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot GT(-1) + C(6) \cdot GT(-2) + C(7) \cdot GT(-3) \]
\[ AR(1)=C(8), AR(3)=C(9), MA(4)=C(10), BACKCAST=1998Q3 \]

8.6. Regression of real net taxes on products and imports on private transfers

\[ RTAXPI = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot PT(-4) + \]
\[ AR(1)=C(5), AR(2)=C(6) \]

8.7. Regression of real net taxes products and imports on lagged Russian real GDP

\[ RTAXPI = C(1) + C(2) \cdot RUSGDP(-4) + \]
\[ AR(4)=C(3), MA(4)=C(4), BACKCAST=1999Q1 \]

8.8. PC1 regression

\[ PC1 = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot PC1(-1) + \]
\[ AR(1)=C(4), AR(2)=C(5) \]
8.9. PC1 regression (with contemporaneous Russian real GDP)

\[ PC1 = C(1) + C(2) \times DUMMY1 + C(3) \times PC1(-1) + C(4) \times RUSGDP + \]
\[ [AR(1)=C(5),AR(2)=C(6)] \]
Table 8.1. Net Taxes on Products and Imports Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.81%</td>
<td>5.82%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Real VAT, real excise taxes, real Russian GDP, and PCs</td>
<td>8.1</td>
<td>No</td>
<td>1.91%</td>
<td>6.10%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>8.2</td>
<td>N/A</td>
<td>15.72%</td>
<td>0.62%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Real VAT</td>
<td>8.3</td>
<td>N/A</td>
<td>-1.32%</td>
<td>4.19%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Labor income</td>
<td>8.4</td>
<td>N/A</td>
<td>8.22%</td>
<td>4.43%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>8.5</td>
<td>N/A</td>
<td>-8.03%</td>
<td>-13.98%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>8.6</td>
<td>N/A</td>
<td>11.78%</td>
<td>2.93%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>8.7</td>
<td>N/A</td>
<td>14.51%</td>
<td>7.49%</td>
</tr>
</tbody>
</table>
Table 8.2. Net Taxes on Products and Imports Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5.82%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Real VAT, real excise taxes, real Russian GDP, and PCs</td>
<td>2.1</td>
<td>No</td>
<td>No</td>
<td>5.96%</td>
</tr>
<tr>
<td>Real taxes on products and imports</td>
<td>Forecast</td>
<td>Real VAT, real excise taxes, real Russian GDP, and PCs</td>
<td>2.1</td>
<td>No</td>
<td>Yes</td>
<td>7.01%</td>
</tr>
</tbody>
</table>
9. Household Consumption

Variables

The dependent variable: real household consumption (RHCONS)

The special variable: real consumer spending on goods and services (released monthly) (RSPEGS)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Electricity production (in physical unit)
- Real household income
- Real U.S. dollar/dram exchange rate
- Real ruble/dram exchange rate
- Real industrial production
- Real fixed investment
- Dwellings completed (in square meters)
- Real retail trade
- Real consumer services
- Real M2
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Real commercial bank deposit rate
- Ratio of consumer prices to industrial producer prices
Household Consumption Regressions

9.1. Regression of real household consumption on real per capita consumer spending on goods and services and principal components

\[ RHCONS = C(1) + C(2) \times DUMMY2 + C(3) \times RHCONS(-4) + C(4) \times RSPENGS + C(5) \times PC3 + C(6) \times PC1(-2) + C(7) \times PC1(-3) + [AR(3) = C(8)] \]

Dependent Variable: RHCONS
Method: Least Squares

Sample (adjusted): 1998Q4 2004Q3
Included observations: 24 after adjustments
Convergence achieved after 7 iterations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-38121.16</td>
<td>11450.80</td>
<td>-3.329126</td>
<td>0.0043</td>
</tr>
<tr>
<td>DUMMY2</td>
<td>12260.91</td>
<td>7079.906</td>
<td>1.731790</td>
<td>0.1025</td>
</tr>
<tr>
<td>RHCONS(-4)</td>
<td>0.753088</td>
<td>0.085774</td>
<td>8.779876</td>
<td>0.0000</td>
</tr>
<tr>
<td>RSPENGS</td>
<td>0.735459</td>
<td>0.160046</td>
<td>4.595302</td>
<td>0.0003</td>
</tr>
<tr>
<td>PC3</td>
<td>1295.927</td>
<td>904.2559</td>
<td>1.433142</td>
<td>0.1711</td>
</tr>
<tr>
<td>PC1(-2)</td>
<td>3371.925</td>
<td>851.6433</td>
<td>3.959316</td>
<td>0.0011</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>-2347.950</td>
<td>678.5329</td>
<td>-3.460333</td>
<td>0.0032</td>
</tr>
<tr>
<td>AR(3)</td>
<td>-0.267834</td>
<td>0.208787</td>
<td>-1.282809</td>
<td>0.2178</td>
</tr>
</tbody>
</table>

R-squared 0.996252 Mean dependent var 289694.6
Adjusted R-squared 0.994612 S.D. dependent var 103394.4
S.E. of regression 7589.388 Akaike info criterion 20.96809
Sum squared resid 9.22E+08 Schwarz criterion 21.36078
Log likelihood -243.6171 F-statistic 607.5462
Durbin-Watson stat 2.278141 Prob(F-statistic) 0.000000

Inverted AR Roots .32+.56i .32-.56i -.64
9.2. Regression of real household consumption on real per capita consumer spending on goods and services

\[ RHCONS = C(1) + C(2)*RHCONS(-4) + C(3)*RSPENS + C(4)*RSPENS(-3) + [MA(4)=C(5),BACKCAST=1998:1] \]

9.3. Regression of real household consumption on real per capita consumer spending on goods and services

\[ RHCONS = C(1) + C(2)*RHCONS(-4) + C(3)*RIND + [MA(5)=C(4),BACKCAST=1998Q1] \]

9.4. Regression of real household consumption on labor income

\[ RHCONS = C(1) + C(2)*RHCONS(-4) + C(3)*LABINC(-2) + C(4)*LABINC(-4) \]

9.5. Regression of real household consumption on government transfers

\[ RHCONS = C(1) + C(2)*DUMMY2 + C(3)*RHCONS(-4) + C(4)*GT(-1) + C(5)*GT(-2) \]

9.6. Regression of real household consumption on private transfers

\[ RHCONS = C(1) + C(2)*DUMMY2 + C(3)*RHCONS(-4) + C(4)*PT(-1) + C(5)*PT(-3) + C(6)*PT(-4) + [MA(5)=C(7),BACKCAST=1998:1] \]

9.7. Regression of real household consumption on real per capita consumer spending on goods and services, principal components, and contemporaneous real Russian GDP

\[ RHCONS = C(1) + C(2)*DUMMY2 + C(3)*RHCONS(-4) + C(4)*RSPENS + C(5)*PC1(-2) + C(6)*PC1(-3) + C(7)*RUSGDP \]

9.8. Regression of real consumer spending on goods and services

\[ RSPENS = C(1) + C(2)*RSPENS(-1) + C(3)*RUSGDP(-2) + [AR(4)=C(4),MA(2)=C(5),MA(3)=C(6),BACKCAST=1998Q3] \]

9.9. ARMA PC3 regression

\[ PC3 = C(1) + C(2)*DUMMY1 + C(3)*DUMMY2 + C(4)*DUMMY3 + [AR(4)=C(5),MA(5)=C(6),BACKCAST=1998Q1] \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real household consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>9.60%</td>
<td>11.70%</td>
</tr>
<tr>
<td>Real consumer spending on goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.73%</td>
<td>9.30%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real consumer spending and PCs</td>
<td>9.1</td>
<td>No</td>
<td>9.96%</td>
<td>11.59%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real consumer spending</td>
<td>9.2</td>
<td>N/A</td>
<td>13.37%</td>
<td>10.90%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>9.3</td>
<td>N/A</td>
<td>10.54%</td>
<td>11.36%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Labor income</td>
<td>9.4</td>
<td>N/A</td>
<td>6.62%</td>
<td>8.79%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>9.5</td>
<td>N/A</td>
<td>6.73%</td>
<td>10.47%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>9.6</td>
<td>N/A</td>
<td>8.80%</td>
<td>8.82%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real consumer spending and PCs</td>
<td>9.7</td>
<td>Yes</td>
<td>9.89%</td>
<td>10.96%</td>
</tr>
</tbody>
</table>
Table 9.2. Household Consumption Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real household consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.70%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real consumer spending and PCs</td>
<td>9.1</td>
<td>No</td>
<td>No</td>
<td>11.30%</td>
</tr>
</tbody>
</table>
10. Government Consumption

Variables

The dependent variable: real government consumption (RGOVCONS)

The special variable: real government budget spending (RBEXP)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Ratio of consumer prices to industrial producer prices
- Real fixed investment
- Real household income
- Real U.S. dollar/dram exchange rate
- Real ruble/dram exchange rate
- Real agricultural production
- Real industrial production
- Freight transportation (tons-kilometers)
- Real retail trade
- Real retail trade inventories
- Real M2
- Merchandise exports (U.S. dollars)
- Merchandise imports (U.S. dollars)
Real Government Consumption Regressions

10.1. Regression of real government consumption on real government budget expenditures, balance of payments indicators, and a principal component

\[ RGOVCONS = C(1) + C(2) \times DUMMY1 + C(3) \times RGOVCONS(-1) + C(4) \times RBEXP + C(5) \times PC1(-3) + C(6) \times GT(-2) + C(7) \times CAPFIN(-2) + [MA(6)=C(8), BACKCAST=1997Q4] \]

Dependent Variable: RGOVCONS
Method: Least Squares

Sample (adjusted): 1997Q4 2004Q3
Included observations: 28 after adjustments
Convergence achieved after 19 iterations
Backcast: 1996Q2 1997Q3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>4607.646</td>
<td>4224.364</td>
<td>1.090731</td>
<td>0.2884</td>
</tr>
<tr>
<td>DUMMY1</td>
<td>-17541.21</td>
<td>2029.877</td>
<td>-8.641515</td>
<td>0.0000</td>
</tr>
<tr>
<td>RGOVCONS(-1)</td>
<td>0.657160</td>
<td>0.093125</td>
<td>7.056739</td>
<td>0.0000</td>
</tr>
<tr>
<td>RBEXP</td>
<td>57.70377</td>
<td>45.45940</td>
<td>1.269347</td>
<td>0.2189</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>499.1218</td>
<td>75.68326</td>
<td>6.594877</td>
<td>0.0000</td>
</tr>
<tr>
<td>GT(-2)</td>
<td>416.9192</td>
<td>65.28430</td>
<td>6.386210</td>
<td>0.0000</td>
</tr>
<tr>
<td>CAPFIN(-2)</td>
<td>-20.44585</td>
<td>10.86638</td>
<td>-1.881569</td>
<td>0.0745</td>
</tr>
<tr>
<td>MA(6)</td>
<td>-0.981754</td>
<td>0.036646</td>
<td>-26.79021</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.968423  Mean dependent var 29808.11
Adjusted R-squared 0.957372  S.D. dependent var 8466.509
S.E. of regression 1748.051  Akaike info criterion 18.00535
Sum squared resid 61113673  Schwarz criterion 18.38598
Log likelihood -244.0749  F-statistic 87.62567
Durbin-Watson stat 1.955870  Prob(F-statistic) 0.000000

Inverted MA Roots 1.00  .50+.86i  .50-.86i  -.50+.86i
                      -.50-.86i    -1.00
10.2. Regression of real government consumption on real government budget expenditures

\[ RGOVCONS = C(1) + C(2)\ast DUMMY1 + C(3)\ast RGOVCONS(-1) + C(4)\ast RBEXP + [MA(6)=C(5),BACKCAST=1997Q2] \]

10.3. Regression of real government consumption on labor income

\[ RGOVCONS = C(1) + C(2)\ast DUMMY1 + C(3)\ast RGOVCONS(-1) + C(4)\ast LABINC(-3) + [MA(6)=C(5),BACKCAST=1997Q4] \]

10.4. Regression of real government consumption on government transfers

\[ RGOVCONS = C(1) + C(2)\ast DUMMY1 + C(3)\ast DUMMY3 + C(4)\ast RGOVCONS(-1) + C(5)\ast GT(-2) + C(6)\ast GT(-4) + [MA(6)=C(7),BACKCAST=1998Q1] \]

10.5. Regression of real government consumption on private transfers

\[ RGOVCONS = C(1) + C(2)\ast DUMMY1 + C(3)\ast RGOVCONS(-1) + C(4)\ast PT(-1) + [MA(6)=C(5),BACKCAST=1997Q2] \]

10.6. Regression of real government consumption on lagged Russian real GDP

\[ RGOVCONS = C(1) + C(2)\ast DUMMY1 + C(3)\ast RGOVCONS(-1) + C(4)\ast RUSGDP(-2) + [MA(6)=C(5),BACKCAST=1997Q3] \]

10.7. Regression of real government consumption on balance of payments indicators and a principal component

\[ RGOVCONS = C(1) + C(2)\ast DUMMY1 + C(3)\ast RGOVCONS(-1) + C(4)\ast PC1(-3) + C(5)\ast GT(-2) + C(6)\ast CAPFIN(-2) + [MA(6)=C(7),BACKCAST=1997Q4] \]

10.8. Real government budget expenditure regression

\[ RBEXP = C(1) + C(2)\ast RBEXP(-4) + C(3)\ast LABINC(-1) + C(4)\ast TCT(-4) + [AR(4)=C(5),MA(6)=C(6),BACKCAST=1999Q1] \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real government consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.00%</td>
<td>17.60%</td>
</tr>
<tr>
<td>Real government budget expenditures</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-6.50%</td>
<td>-4.91%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real government budget expenditures, balance of payments, and PC</td>
<td>10.1</td>
<td>No</td>
<td>13.16%</td>
<td>18.05%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real government budget expenditures</td>
<td>10.2</td>
<td>N/A</td>
<td>-11.09%</td>
<td>-5.54%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Labor income</td>
<td>10.3</td>
<td>N/A</td>
<td>-0.71%</td>
<td>10.53%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>10.4</td>
<td>N/A</td>
<td>-4.30%</td>
<td>0.53%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>10.5</td>
<td>N/A</td>
<td>2.09%</td>
<td>21.93%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>10.6</td>
<td>N/A</td>
<td>-0.66%</td>
<td>3.42%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Balance of payments and PC</td>
<td>10.7</td>
<td>N/A</td>
<td>19.30%</td>
<td>25.52%</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>Official or forecast</td>
<td>Independent variables</td>
<td>Regression number</td>
<td>Contemporaneous Russian GDP in regression for dependent variable</td>
<td>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</td>
<td>2004 III</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>-------------------</td>
<td>---------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>17.60%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real government budget expenditures, balance of payments, and PC</td>
<td>10.1</td>
<td>No</td>
<td>No</td>
<td>17.78%</td>
</tr>
</tbody>
</table>
11. Investment

Variables

The dependent variable: real gross investment (RINVNA)

The special variable: real fixed investment (released monthly) (RINVEST)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real household income
- Real consumer spending on goods and services
- Real dram/U.S. dollar exchange rate
- Real dram/Russian ruble exchange rate
- Real agricultural production
- Real industrial production
- Dwellings completed (in square meters)
- Freight transportation (in tons-kilometers)
- Real retail trade
- Real retail trade inventories
- Real M2
- Real commercial bank credit rate
- Merchandise exports (in U.S. dollars)
- Imports of machinery and equipment (in U.S. dollars)
- Ratio of consumer prices to investment prices
Real Investment Regressions

11.1. Regression of real investment on real fixed investment ("monthly" methodology) and principal components

\[ RINVNA = C(1) + C(2) \times RINVNA(-4) + C(3) \times RINVEST + C(4) \times PC5 + C(5) \times PC1(-1) + C(6) \times PC8(-2) + C(7) \times PC5(-3) \]

Dependent Variable: RINVNA
Method: Least Squares

Sample (adjusted): 1998Q1 2003Q3
Included observations: 23 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3103.949</td>
<td>2498.424</td>
<td>1.242363</td>
<td>0.2320</td>
</tr>
<tr>
<td>RINVNA(-4)</td>
<td>0.557908</td>
<td>0.100454</td>
<td>5.553883</td>
<td>0.0000</td>
</tr>
<tr>
<td>RINVEST</td>
<td>0.945456</td>
<td>0.164032</td>
<td>5.763854</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC5</td>
<td>-1714.423</td>
<td>964.3604</td>
<td>-1.777782</td>
<td>0.0944</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-364.6722</td>
<td>255.8219</td>
<td>-1.425493</td>
<td>0.1732</td>
</tr>
<tr>
<td>PC8(-2)</td>
<td>1815.254</td>
<td>1029.352</td>
<td>1.763492</td>
<td>0.0969</td>
</tr>
<tr>
<td>PC5(-3)</td>
<td>-1038.777</td>
<td>688.6831</td>
<td>-1.508353</td>
<td>0.1510</td>
</tr>
</tbody>
</table>

R-squared 0.980681  Mean dependent var 53985.29
Adjusted R-squared 0.973436  S.D. dependent var 29216.23
S.E. of regression 4761.758  Akaike info criterion 20.02041
Sum squared resid 3.63E+08  Schwarz criterion 20.36600
Log likelihood -223.2347  F-statistic 135.3670
Durbin-Watson stat 2.432394  Prob(F-statistic) 0.000000
11.2. Regression of real investment on real fixed investment (“monthly” methodology)

\[ RINVNA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)DUMMY3 + C(5)RINVEST + [AR(1)=C(6),MA(2)=C(7),BACKCAST=1997:2] \]

11.3. Regression of real investment on labor income

\[ RINVNA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)LABINC(-4) + [AR(1)=C(5),MA(4)=C(6),BACKCAST=1998:2] \]

11.4. Regression of real investment on government transfers

\[ RINVNA = C(1) + C(2)RINVNA(-4) + C(3)GT(-1) + C(4)GT(-2) + [MA(6)=C(5),BACKCAST=1998:1] \]

11.5. Regression of real investment on private transfers

\[ RINVNA = C(1) + C(2)DUMMY1 + C(3)DUMMY2 + C(4)PT(-4) + [AR(1)=C(5),AR(2)=C(6),MA(5)=C(7),BACKCAST=1998:3] \]

11.6. Regression of real investment on lagged Russian real GDP

\[ RINVNA = C(1) + C(2)DUMMY3 + C(3)RINVNA(-4) + C(4)RUSGDP(-2) + C(5)RUSGDP(-4) + [MA(6)=C(7),BACKCAST=1998:1] \]

11.7. Regression of real investment on real fixed investment (“monthly” methodology), principal components, and real contemporaneous Russian GDP

\[ RINVNA = C(1) + C(2)RINVNA(-4) + C(3)RINVEST + C(4)PC5 + C(5)PC1(-1) + C(6)PC8(-2) + C(7)PC5(-3) + C(8)RUSGDP \]

11.8. Real fixed investment regression

\[ RINVEST = C(1) + C(2)RINVEST(-4) + C(3)RUSGDP(-4) + [AR(4)=C(5),MA(5)=C(6),BACKCAST=1999Q1] \]

11.9. PC5 regression

\[ PC5 = C(1) + C(2)DUMMY4 + C(3)PC5(-1) + C(4)TCT(-2) + C(5)TCT(-4) + C(6)FDI(-4) + C(7)RUSGDP(-1) + [MA(6)=C(8),BACKCAST=1998Q1] \]

11.10. Real fixed investment regression (contemporaneous Russian real GDP included)

\[ RINVEST = C(1) + C(2)RINVEST(-4) + C(3)RUSGDP + C(4)RUSGDP(-4) + [AR(4)=C(5),MA(5)=C(6),BACKCAST=1999Q1] \]
11.11. PC5 regression (contemporaneous Russian real GDP included)

\[ PC5 = C(1) + C(2) \times DUMMY4 + C(3) \times PC5(-1) + C(4) \times TCT(-2) + C(5) \times TCT(-4) + C(6) \times FDI(-4) + C(7) \times RUSGDP + [MA(6)=C(8), BACKCAST=1998Q1] \]
Table 11.1. Investment Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>9.20%</td>
<td>8.90%</td>
</tr>
<tr>
<td>Real fixed investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.30%</td>
<td>20.49%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real fixed investment and PCs</td>
<td>11.1</td>
<td>No</td>
<td>9.43%</td>
<td>9.56%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real fixed investment</td>
<td>11.2</td>
<td>N/A</td>
<td>0.76%</td>
<td>16.19%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Labor income</td>
<td>11.3</td>
<td>N/A</td>
<td>2.77%</td>
<td>-4.65%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>11.4</td>
<td>N/A</td>
<td>29.01%</td>
<td>26.80%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>11.5</td>
<td>N/A</td>
<td>22.24%</td>
<td>16.92%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>11.6</td>
<td>N/A</td>
<td>18.14%</td>
<td>7.46%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real fixed investment and PCs</td>
<td>11.7</td>
<td>Yes</td>
<td>13.76%</td>
<td>13.26%</td>
</tr>
</tbody>
</table>
Table 11.2. Investment Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>8.90%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real fixed investment and PCs</td>
<td>11.1</td>
<td>No</td>
<td>No</td>
<td>9.12%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real fixed investment and PCs</td>
<td>11.8</td>
<td>No</td>
<td>Yes</td>
<td>11.11%</td>
</tr>
</tbody>
</table>
12. Net Exports

Variables

The dependent variable: real net exports of goods and services (RTB)

The special variable: net merchandise exports (in U.S. dollars) (released monthly) (NETEXP)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real household income
- Real consumer spending on goods and services
- Real U.S. dollar/dram exchange rate
- Real ruble/dram exchange rate
- Real agricultural production
- Real industrial production
- Real fixed investment
- Dwellings completed (in square meters)
- Freight transportation (in tons-kilometers)
- Real retail trade
- Real retail trade inventories
- Real M2
- Real commercial bank credit rate
- Ratio of consumer prices to industrial producer prices
- Ratio of consumer prices to transportation prices
Real Net Exports Regressions

12.1. Regression of real net exports of goods and services on net merchandise exports (in U.S. dollars), net transportation services (in U.S. dollars), and a principal component

\[ RTB = C(1) + C(2)\ast DUMMY2 + C(3)\ast NETEXP + C(4)\ast PC3 + C(5)\ast TRANSPSERV + C(6)\ast TRANSPSERV(-4) + [MA(6)=C(7), BACKCAST=1998:1] \]

Dependent Variable: RTB
Method: Least Squares

Sample(adjusted): 1998:1 2004:3
Included observations: 27 after adjusting endpoints
Convergence achieved after 21 iterations
Backcast: 1996:3 1997:4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>33369.05</td>
<td>4853.554</td>
<td>6.875179</td>
<td>0.0000</td>
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<tr>
<td>DUMMY2</td>
<td>3517.326</td>
<td>1472.791</td>
<td>2.388204</td>
<td>0.0269</td>
</tr>
<tr>
<td>NETEXP</td>
<td>0.438813</td>
<td>0.033784</td>
<td>12.98878</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC3</td>
<td>-2934.900</td>
<td>246.9912</td>
<td>-11.88261</td>
<td>0.0000</td>
</tr>
<tr>
<td>TRANSPSERV</td>
<td>827.1484</td>
<td>185.4232</td>
<td>4.460868</td>
<td>0.0002</td>
</tr>
<tr>
<td>TRANSPSERV(-4)</td>
<td>1688.594</td>
<td>379.9826</td>
<td>4.443873</td>
<td>0.0002</td>
</tr>
<tr>
<td>MA(6)</td>
<td>0.978826</td>
<td>0.020530</td>
<td>-47.67719</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.979271
Adjusted R-squared 0.973053
S.E. of regression 2733.240
Akaike info criterion 18.88278
Schwarz criterion 19.21874
F-statistic 157.4742
Prob(F-statistic) 0.000000

Inverted MA Roots 1.00 .50+.86i .50 -.86i .50+.86i
                  -.50 -.86i -1.00

430
12.2. Regression of real net exports of goods and services on net merchandise exports (in U.S. dollars)

\[ RTB = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot NETEXP + [MA(6)=C(5), BACKCAST=1997:1] \]

12.3. Regression of real net exports of goods and services on labor income

\[ RTB = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot LABINC(-3) + [AR(1)=C(6), MA(6)=C(7), BACKCAST=1998:1] \]

12.4. Regression of real net exports of goods and services on government transfers

\[ RTB = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot GT(-4) + [AR(1)=C(6), MA(4)=C(7), MA(6)=C(8), BACKCAST=1998:2] \]

12.5. Regression of real net exports of goods and services on private transfers

\[ RTB = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot PT(-3) + [AR(1)=C(6), MA(6)=C(7), BACKCAST=1998:1] \]

12.6. Regression of real net exports of goods and services on lagged Russian real GDP

\[ RTB = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot RUSGDP(-3) + [AR(1)=C(6), MA(6)=C(7), BACKCAST=1998:1] \]

12.7. Regression of net merchandise exports

\[ NETEXP = C(1) + C(2) \cdot DUMMY1 + C(3) \cdot DUMMY2 + C(4) \cdot DUMMY3 + C(5) \cdot LABINC(-3) + C(6) \cdot PT(-2) + C(7) \cdot RUSGDP(-2) + [AR(2)=C(8), AR(4)=C(9), MA(4)=C(10), BACKCAST=1998:4] \]

12.8. Regression of net transportation services

\[ TRANSPSERV = C(1) + C(2) \cdot DUMMY3 + C(3) \cdot TRANSPSERV(-1) + C(4) \cdot RUSGDP(-4) + [MA(1)=C(5), MA(6)=C(6), BACKCAST=1998:1] \]

12.9. Regression of PC3

\[ PC3 = C(1) + C(2) \cdot DUMMY2 + C(3) \cdot DUMMY3 + C(4) \cdot PC3(-1) + [MA(6)=C(5), BACKCAST=1997:2] \]
Table 12.1. Net Exports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real net exports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-11.90%</td>
<td>-10.80%</td>
</tr>
<tr>
<td>Net merchandise exports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-8.22%</td>
<td>15.54%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Net merchandise exports, net transportation services, and PC</td>
<td>12.1</td>
<td>No</td>
<td>-13.47%</td>
<td>-10.87%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Net merchandise exports</td>
<td>12.2</td>
<td>N/A</td>
<td>-8.20%</td>
<td>-6.58%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Labor income</td>
<td>12.3</td>
<td>N/A</td>
<td>3.07%</td>
<td>2.74%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Government transfers</td>
<td>12.4</td>
<td>N/A</td>
<td>-10.46%</td>
<td>-9.40%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Private transfers</td>
<td>12.5</td>
<td>N/A</td>
<td>1.47%</td>
<td>9.54%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Lagged Russian real GDP</td>
<td>12.6</td>
<td>N/A</td>
<td>6.44%</td>
<td>10.22%</td>
</tr>
</tbody>
</table>
Table 12.2. Net Exports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Contemporaneous Russian GDP in regression for dependent variable</th>
<th>Contemporaneous Russian GDP in regressions for contemporaneous independent variables</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real net exports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-10.80%</td>
</tr>
<tr>
<td>Real net exports</td>
<td>Forecast</td>
<td>Net merchandise exports, net transportation services, and PC</td>
<td>12.1</td>
<td>No</td>
<td>No</td>
<td>-11.51%</td>
</tr>
</tbody>
</table>
13. Total GDP Deflator

Variables

The dependent variable: ratio of nominal GDP to real GDP (GDPDEFL)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real industrial production
- Real retail trade
- Real retail trade inventories
- Nominal dram/ U.S. dollar exchange rate
- Nominal dram/Russian ruble exchange rate
- Nominal M2
- Nominal commercial bank credit rate
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Industrial producer prices
- Investment prices
- Freight transportation prices
- Agricultural producer prices
- Goods consumer prices
- Services consumer prices
13.1. Regression of GDP deflator on principal components

\[ GDPDEFL = C(1) + C(2)*DUMMY3 + C(3)*GDPDEFL(-2) + C(4)*PC1 + C(5)*PC2 + C(6)*PC3 + [MA(3)=C(7),MA(5)=C(8),BACKCAST=1997Q3] \]

Dependent Variable: GDPDEFL  
Method: Least Squares

Sample (adjusted): 1997Q3 2004Q3  
Included observations: 29 after adjustments  
Failure to improve SSR after 20 iterations  
Backcast: 1996Q2 1997Q2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>70.02637</td>
<td>6.462115</td>
<td>10.83645</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMY3</td>
<td>-2.841437</td>
<td>0.489172</td>
<td>-5.808671</td>
<td>0.0000</td>
</tr>
<tr>
<td>GDPDEFL(-2)</td>
<td>0.334388</td>
<td>0.064134</td>
<td>5.213869</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>0.411203</td>
<td>0.059329</td>
<td>6.930907</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>0.495995</td>
<td>0.056116</td>
<td>8.838801</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC3</td>
<td>0.546996</td>
<td>0.076877</td>
<td>7.115247</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(3)</td>
<td>-0.331615</td>
<td>0.124454</td>
<td>-2.664564</td>
<td>0.0145</td>
</tr>
<tr>
<td>MA(5)</td>
<td>0.714621</td>
<td>0.127982</td>
<td>5.583778</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.976685  
Adjusted R-squared: 0.968913  
S.E. of regression: 1.120497  
Akaike info criterion: 3.294373  
Schwarz criterion: 3.671558  
Log likelihood: -39.76840  
F-statistic: 125.6717  
Prob(F-statistic): 0.000000  

Inverted MA Roots: .78-.48i, .78+.48i, -.35+.93i, -.35-.93i

-.86
13.2. Regression of GDP deflator on consumer prices

\[ GDPDEFL = C(1) + C(2) \times DUMMY3 + C(3) \times GDPDEFL(-2) + C(4) \times CPI + [MA(5)=C(5), BACKCAST=1997Q3] \]

13.3. Regression of GDP deflator on industrial producer prices

\[ GDPDEFL = C(1) + C(2) \times DUMMY3 + C(3) \times DUMMY4 + C(4) \times GDPDEFL(-2) + C(5) \times IPI + [AR(1)=C(6), MA(5)=C(7), BACKCAST=1997Q4] \]

13.4. Regression of GDP deflator on agricultural producer prices

\[ GDPDEFL = C(1) + C(2) \times DUMMY3 + C(3) \times GDPDEFL(-2) + C(4) \times APPR + C(5) \times APPR(-1) + [MA(3)=C(6), BACKCAST=1997Q3] \]

13.5. Regression of GDP deflator on freight transportation prices

\[ GDPDEFL = C(1) + C(2) \times DUMMY1 + C(3) \times GDPDEFL(-2) + C(4) \times TTRPR + [MA(3)=C(5), MA(5)=C(6), BACKCAST=1997Q3] \]

13.6. Regression of GDP deflator on real retail trade inventories

\[ GDPDEFL = C(1) + C(2) \times DUMMY3 + C(3) \times RINVENT + [MA(5)=C(4), BACKCAST=1997Q1] \]

13.7. Regression of GDP deflator on merchandise imports (in U.S. dollars)

\[ GDPDEFL = C(1) + C(2) \times DUMMY2 + C(3) \times DUMMY3 + C(4) \times GDPDEFL(-2) + C(5) \times IMP + [MA(3)=C(6), MA(5)=C(7), BACKCAST=1997Q3] \]

13.8. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \times DUMMY4 + C(3) \times PC1(-1) + [MA(5)=C(4), BACKCAST=1997Q2] \]

13.9. ARMA PC2 regression

\[ PC2 = C(1) + C(2) \times PC2(-1) + C(3) \times PC2(-3) + [MA(4)=C(4), BACKCAST=1997Q4] \]

13.10. ARMA PC3 regressions

\[ PC3 = C(1) + C(2) \times DUMMY1 + C(3) \times DUMMY2 + C(4) \times DUMMY3 + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q2] \]
Table 13.1. GDP Deflator Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP deflator</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>6.14%</td>
<td>7.99%</td>
</tr>
<tr>
<td>Consumer prices</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>7.32%</td>
<td>8.39%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>PCs</td>
<td>13.1</td>
<td>6.10%</td>
<td>7.84%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Consumer prices</td>
<td>13.2</td>
<td>6.17%</td>
<td>7.20%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Industrial producer prices</td>
<td>13.3</td>
<td>7.08%</td>
<td>8.18%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Agricultural producer prices</td>
<td>13.4</td>
<td>5.12%</td>
<td>6.70%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Freight transportation prices</td>
<td>13.5</td>
<td>2.21%</td>
<td>0.34%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Real retail trade inventories</td>
<td>13.6</td>
<td>3.16%</td>
<td>8.83%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>13.7</td>
<td>4.69%</td>
<td>2.65%</td>
</tr>
</tbody>
</table>
Table 13.2. GDP Deflator Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP deflator</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>7.99%</td>
</tr>
<tr>
<td>GDP deflator</td>
<td>Forecast</td>
<td>PCs</td>
<td>13.1</td>
<td>7.75%</td>
</tr>
</tbody>
</table>
Table 13.3. Partial Derivatives of GDP Deflator with Respect to:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real industrial production</td>
<td>-0.0488</td>
</tr>
<tr>
<td>Real retail trade</td>
<td>-0.1305</td>
</tr>
<tr>
<td>Real retail trade inventories</td>
<td>0.0807</td>
</tr>
<tr>
<td>Nominal dram/U.S. dollar exchange rate</td>
<td>0.0215</td>
</tr>
<tr>
<td>Nominal dram/Russian ruble exchange rate</td>
<td>0.0651</td>
</tr>
<tr>
<td>Nominal M2</td>
<td>0.1168</td>
</tr>
<tr>
<td>Nominal commercial bank credit rate</td>
<td>-0.0469</td>
</tr>
<tr>
<td>Merchandise exports (in U.S. dollars)</td>
<td>0.1399</td>
</tr>
<tr>
<td>Merchandise imports (in U.S. dollars)</td>
<td>0.0327</td>
</tr>
<tr>
<td>Industrial producer prices</td>
<td>0.2571</td>
</tr>
<tr>
<td>Investment prices</td>
<td>0.1164</td>
</tr>
<tr>
<td>Freight transportation prices</td>
<td>0.1924</td>
</tr>
<tr>
<td>Agricultural producer prices</td>
<td>0.5221</td>
</tr>
<tr>
<td>Goods consumer prices</td>
<td>0.5008</td>
</tr>
<tr>
<td>Services consumer prices</td>
<td>0.0845</td>
</tr>
</tbody>
</table>
14. Nominal GDP

Variables

The dependent variable: nominal GDP (NGDP)

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Nominal agricultural production
- Nominal industrial production
- Nominal retail trade
- Nominal consumer services
- Nominal fixed investment
- Nominal retail trade inventories
- Nominal dram/ U.S. dollar exchange rate
- Nominal dram/Russian ruble exchange rate
- Nominal M2
- Nominal commercial bank credit rate
- Merchandise exports (in U.S. dollars)
- Merchandise imports (in U.S. dollars)
- Industrial producer prices
- Investment prices
- Freight transportation prices
Nominal GDP Regressions

14.1. Regression of nominal GDP on principal components

\[ NGDP = C(1) + C(2) \cdot NGDP(-1) + C(3) \cdot NGDP(-2) + C(4) \cdot NGDP(-4) + C(5) \cdot PC1 + C(6) \cdot PC2 + C(7) \cdot PC3 + [MA(5)=C(8), BACKCAST=1998Q1] \]

Dependent Variable: NGDP  
Method: Least Squares

Sample (adjusted): 1998Q1 2004Q3  
Included observations: 27 after adjustments  
Convergence achieved after 27 iterations  
Backcast: 1996Q4 1997Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>210995.9</td>
<td>20012.92</td>
<td>10.54298</td>
<td>0.000</td>
</tr>
<tr>
<td>NGDP(-1)</td>
<td>-0.085405</td>
<td>0.015142</td>
<td>-5.640193</td>
<td>0.000</td>
</tr>
<tr>
<td>NGDP(-2)</td>
<td>-0.160212</td>
<td>0.031395</td>
<td>-5.103164</td>
<td>0.001</td>
</tr>
<tr>
<td>NGDP(-4)</td>
<td>0.543624</td>
<td>0.056667</td>
<td>9.593357</td>
<td>0.000</td>
</tr>
<tr>
<td>PC1</td>
<td>-9202.110</td>
<td>635.5939</td>
<td>-14.47797</td>
<td>0.000</td>
</tr>
<tr>
<td>PC2</td>
<td>6534.776</td>
<td>1194.151</td>
<td>5.472320</td>
<td>0.000</td>
</tr>
<tr>
<td>PC3</td>
<td>-6883.661</td>
<td>1423.540</td>
<td>-4.835593</td>
<td>0.001</td>
</tr>
<tr>
<td>MA(5)</td>
<td>-0.987541</td>
<td>0.023934</td>
<td>-41.26119</td>
<td>0.000</td>
</tr>
</tbody>
</table>

R-squared: 0.998412  
Mean dependent var: 310335.7

Adjusted R-squared: 0.997827  
S.D. dependent var: 139374.6

S.E. of regression: 6496.521  
Akaike info criterion: 20.63712

Sum squared resid: 8.02E+08  
Schwarz criterion: 21.02107

Log likelihood: -270.6011  
F-statistic: 1706.833

Durbin-Watson stat: 1.847559  
Prob(F-statistic): 0.000000

Inverted MA Roots: 1.00  .31-.95i  .31+.95i  -.81+.59i  -.81-.59i
14.2. Regression of nominal GDP on nominal agricultural production

\[ \text{NGDP} = C(1) + C(2) \times \text{NGDP}(-2) + C(3) \times \text{NGDP}(-4) + C(4) \times \text{NAGR} + [\text{MA}(5)=C(5), \text{BACKCAST}=1998:1] \]

14.3. Regression of nominal GDP on nominal industrial production

\[ \text{NGDP} = C(1) + C(2) \times \text{NGDP}(-4) + C(3) \times \text{NIND} + [\text{MA}(6)=C(4), \text{BACKCAST}=1998Q1] \]

14.4. Regression of nominal GDP on nominal retail trade

\[ \text{NGDP} = C(1) + C(2) \times \text{NGDP}(-2) + C(3) \times \text{NGDP}(-4) + C(4) \times \text{NTRADE} + C(5) \times \text{NTRADE}(-3) + [\text{MA}(6)=C(6), \text{BACKCAST}=1998Q1] \]

14.5. Regression of nominal GDP on nominal M2

\[ \text{NGDP} = C(1) + C(2) \times \text{NGDP}(-4) + C(3) \times \text{NM2X} + [\text{MA}(5)=C(4), \text{BACKCAST}=1998Q1] \]

14.6. Regression of nominal GDP on merchandise imports

\[ \text{NGDP} = C(1) + C(2) \times \text{NGDP}(-4) + C(3) \times \text{IMP} + C(4) \times \text{IMP}(-1) + [\text{MA}(1)=C(5), \text{MA}(5)=C(6), \text{BACKCAST}=1998Q1] \]

14.7. Regression of nominal GDP on the nominal dram/Russian ruble exchange rate

\[ \text{NGDP} = C(1) + C(2) \times \text{NGDP}(-4) + C(3) \times \text{NRUBEXR} + C(4) \times \text{NRUBEXR}(-1) + C(5) \times \text{NRUBEXR}(-3) + [\text{AR}(2)=C(6), \text{AR}(3)=C(7), \text{MA}(2)=C(8), \text{BACKCAST}=1998Q4] \]

14.8. PC1 regression

\[ \text{PC1} = C(1) + C(2) \times \text{PC1}(-4) + [\text{AR}(1)=C(3)] \]

14.9. PC2 regression

\[ \text{PC2} = C(1) + C(2) \times \text{PC2}(-4) + [\text{AR}(1)=C(3), \text{MA}(1)=C(4), \text{MA}(5)=C(5), \text{BACKCAST}=1998:2] \]

14.10. PC3 regression

\[ \text{PC3} = C(1) + C(2) \times \text{DUMMY2} + C(3) \times \text{PC3}(-4) + [\text{AR}(1)=C(4), \text{MA}(3)=C(5), \text{BACKCAST}=1998:2] \]
Table 14.1. Nominal GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>2004 II</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>16.97%</td>
<td>20.31%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>14.1</td>
<td>16.04%</td>
<td>19.24%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal agricultural production</td>
<td>14.2</td>
<td>22.13%</td>
<td>21.32%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal industrial production</td>
<td>14.3</td>
<td>20.50%</td>
<td>18.83%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal retail trade</td>
<td>14.4</td>
<td>15.57%</td>
<td>17.49%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal M2</td>
<td>14.5</td>
<td>18.27%</td>
<td>16.89%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Merchandise imports</td>
<td>14.6</td>
<td>23.16%</td>
<td>17.99%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal dram/ruble exchange rate</td>
<td>14.7</td>
<td>19.56%</td>
<td>18.08%</td>
</tr>
</tbody>
</table>
Table 14.2. Nominal GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>2004 III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>20.31%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>14.1</td>
<td>20.57%</td>
</tr>
</tbody>
</table>
Table 14.3. Partial derivatives of Nominal GDP with Respect to:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal agricultural production</td>
<td>7802</td>
</tr>
<tr>
<td>Nominal industrial production</td>
<td>1969</td>
</tr>
<tr>
<td>Nominal retail trade</td>
<td>5004</td>
</tr>
<tr>
<td>Nominal consumer services</td>
<td>5379</td>
</tr>
<tr>
<td>Nominal fixed investment</td>
<td>5342</td>
</tr>
<tr>
<td>Nominal retail trade inventories</td>
<td>1468</td>
</tr>
<tr>
<td>Nominal dram/ U.S. dollar exchange rate</td>
<td>966</td>
</tr>
<tr>
<td>Nominal dram/Russian ruble exchange rate</td>
<td>-2826</td>
</tr>
<tr>
<td>Nominal M2</td>
<td>1757</td>
</tr>
<tr>
<td>Nominal commercial bank credit rate</td>
<td>-2078</td>
</tr>
<tr>
<td>Merchandise exports (in U.S. dollars)</td>
<td>669</td>
</tr>
<tr>
<td>Merchandise imports (in U.S. dollars)</td>
<td>2008</td>
</tr>
<tr>
<td>Industrial producer prices</td>
<td>796</td>
</tr>
<tr>
<td>Investment prices</td>
<td>1911</td>
</tr>
<tr>
<td>Freight transportation prices</td>
<td>524</td>
</tr>
</tbody>
</table>
Appendix C. Czech Model Regressions and Forecast Summary Tables

Crisis Dummy Variables

Intercept Dummy Variable:

DUMMY1 = 0 for 1996Q1 – 1997Q2, = 1 otherwise

Slope Dummy Variables: ‘DUMMY’ is added to the name of the variable

1. GDP

Variables

The dependent variable: real GDP (GDP), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of exports to imports
- Ratio of government budget expenditures to revenues
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Business confidence index
Real GDP Regressions

1.1. Regression of real GDP on principal components

\[ GDP = C(1) + C(2)PC1 + C(3)PC6(-2) + C(4)PC3(-3) + [AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997Q2] \]

Dependent Variable: GDP
Method: Least Squares

Sample (adjusted): 1997Q2 2004Q4
Included observations: 31 after adjustments
Convergence achieved after 27 iterations
Backcast: 1996Q2 1997Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>102.4911</td>
<td>0.275668</td>
<td>371.7919</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.448665</td>
<td>0.121300</td>
<td>-3.698800</td>
<td>0.0011</td>
</tr>
<tr>
<td>PC6(-2)</td>
<td>0.163842</td>
<td>0.126086</td>
<td>1.299450</td>
<td>0.2061</td>
</tr>
<tr>
<td>PC3(-3)</td>
<td>0.298529</td>
<td>0.159885</td>
<td>1.867151</td>
<td>0.0741</td>
</tr>
<tr>
<td>AR(1)</td>
<td>1.257516</td>
<td>0.198228</td>
<td>6.343779</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.434997</td>
<td>0.174077</td>
<td>-2.498874</td>
<td>0.0197</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.898687</td>
<td>0.043324</td>
<td>-20.74352</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared      0.965979  Mean dependent var  101.9006
Adjusted R-squared 0.957474  S.D. dependent var  2.096135
S.E. of regression 0.432260  Akaike info criterion  1.356102
Sum squared resid 4.484374  Schwarz criterion  1.679905
Log likelihood   -14.01958  F-statistic  113.5758
Durbin-Watson stat 1.935670  Prob(F-statistic)  0.000000

Inverted AR Roots  \(0.63-0.20i\)  \(0.63+0.20i\)
Inverted MA Roots  \(0.97\)  \(0.00+0.97i\)  \(-0.00-0.97i\)  \(-0.97\)
1.2. Regression of real GDP on real manufacturing production

\[ GDP = C(1) + C(2) \times DUMMY1 + C(3) \times MNFC + C(4) \times DUMMYMNFC + \]
\[ [AR(1)=C(5),MA(4)=C(6),BACKCAST=1996Q2] \]

1.3. Regression of real GDP on real transportation sales

\[ GDP = C(1) + C(2) \times TRANSPORT + C(3) \times TRANSPORT(-1) + C(4) \times TRANSPORT(-2) + C(5) \times TRANSPORT(-4) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997Q2] \]

1.4. Regression of real GDP on the unemployment rate

\[ GDP = C(1) + C(2) \times DUMMY1 + C(3) \times UNEMPL(-2) + C(4) \times UNEMPL(-3) + C(5) \times UNEMPL(-4) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997Q2] \]

1.5. Regression of real GDP on real average industrial wage

\[ GDP = C(1) + C(2) \times DUMMY1 + C(3) \times WAGE + [AR(1)=C(4),AR(2)=C(5),MA(4)=C(6),BACKCAST=1996Q3] \]

1.6. Regression of real GDP on the ratio of consumer prices to industrial producer prices

\[ GDP = C(1) + C(2) \times CPIIPI + C(3) \times CPIIPI(-3) + C(4) \times CPIIPI(-4) + [AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997Q3] \]

1.7. Regression of real GDP on real M2

\[ GDP = C(1) + C(2) \times M2 + C(3) \times M2(-3) + [AR(1)=C(4),AR(2)=C(5),MA(4)=C(6),BACKCAST=1997Q2] \]

1.8. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \times PC1(-1) + C(3) \times PC1(-2) + [MA(4)=C(4),BACKCAST=1996Q3] \]
Table 1.1. GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.03%</td>
<td>4.30%</td>
<td></td>
</tr>
<tr>
<td>Real GDP Forecast</td>
<td>PCs</td>
<td>1.1</td>
<td>No</td>
<td>4.10%</td>
<td>4.18%</td>
<td></td>
</tr>
<tr>
<td>Real GDP Forecast</td>
<td>Real manufacturing production</td>
<td>1.2</td>
<td>Yes</td>
<td>3.65%</td>
<td>4.23%</td>
<td></td>
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<tr>
<td>Real GDP Forecast</td>
<td>Real transportation sales</td>
<td>1.3</td>
<td>No</td>
<td>4.15%</td>
<td>3.81%</td>
<td></td>
</tr>
<tr>
<td>Real GDP Forecast</td>
<td>Unemployment rate</td>
<td>1.4</td>
<td>Yes</td>
<td>4.48%</td>
<td>4.54%</td>
<td></td>
</tr>
<tr>
<td>Real GDP Forecast</td>
<td>Real average industrial wage</td>
<td>1.5</td>
<td>Yes</td>
<td>4.88%</td>
<td>5.40%</td>
<td></td>
</tr>
<tr>
<td>Real GDP Forecast</td>
<td>Ratio of consumer prices to industrial producer prices</td>
<td>1.6</td>
<td>No</td>
<td>4.86%</td>
<td>4.92%</td>
<td></td>
</tr>
<tr>
<td>Real GDP Forecast</td>
<td>Real M2</td>
<td>1.7</td>
<td>No</td>
<td>4.29%</td>
<td>4.68%</td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2. GDP Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.30%</td>
</tr>
<tr>
<td>Real GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>1.1</td>
<td>No</td>
<td>4.25%</td>
</tr>
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</table>
Table 1.3. Partial Derivatives of GDP with Respect to:

<table>
<thead>
<tr>
<th>Description</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real mining production</td>
<td>0.1208</td>
</tr>
<tr>
<td>Real manufacturing production</td>
<td>0.1051</td>
</tr>
<tr>
<td>Real utilities production</td>
<td>0.0990</td>
</tr>
<tr>
<td>Real construction</td>
<td>0.1399</td>
</tr>
<tr>
<td>Real transportation sales</td>
<td>0.1499</td>
</tr>
<tr>
<td>Real retail trade</td>
<td>0.1347</td>
</tr>
<tr>
<td>Ratio of exports to imports</td>
<td>-0.1026</td>
</tr>
<tr>
<td>Ratio of government budget expenditures to revenues</td>
<td>-0.0016</td>
</tr>
<tr>
<td>Real M2</td>
<td>0.0182</td>
</tr>
<tr>
<td>Real koruna/U.S. dollar exchange rate</td>
<td>-0.0264</td>
</tr>
<tr>
<td>Real koruna/euro exchange rate</td>
<td>-0.0324</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>-0.1769</td>
</tr>
<tr>
<td>Real average industrial wage</td>
<td>0.0917</td>
</tr>
<tr>
<td>Ratio of consumer prices to industrial producer prices</td>
<td>-0.1109</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>-0.1215</td>
</tr>
<tr>
<td>Business confidence index</td>
<td>0.1622</td>
</tr>
</tbody>
</table>
2. Manufacturing

Variables

The dependent variable: real manufacturing value-added (MNFCVA), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports (in U.S. dollars)
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Ratio of utilities producer prices to manufacturing producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Manufacturing Value-Added Regressions

2.1. Regression of real manufacturing value-added on principal components

\[
MNFCVA = C(1) + C(2)\times PC1(-4) + C(3)\times DUMMYPC1(-4) + C(4)\times PC5 + [AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q2]
\]

Dependent Variable: MNFCVA
Method: Least Squares

Sample (adjusted): 1997Q2 2004Q4
Included observations: 31 after adjustments
Convergence achieved after 14 iterations
Backcast: 1996Q2 1997Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>114.9161</td>
<td>7.068106</td>
<td>16.25839</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>6.559802</td>
<td>2.271563</td>
<td>2.887793</td>
<td>0.0079</td>
</tr>
<tr>
<td>DUMMYPC1(-4)</td>
<td>-4.605917</td>
<td>1.994497</td>
<td>-2.309313</td>
<td>0.0295</td>
</tr>
<tr>
<td>PC5</td>
<td>-1.557844</td>
<td>0.743709</td>
<td>-2.094697</td>
<td>0.0465</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.910707</td>
<td>0.054558</td>
<td>16.69260</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.977061</td>
<td>0.020677</td>
<td>-47.25390</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.878629 Mean dependent var 104.1490
Adjusted R-squared 0.854355 S.D. dependent var 8.169908
S.E. of regression 3.117921 Akaike info criterion 5.284196
Sum squared resid 243.0359 Schwarz criterion 5.561742
Log likelihood -75.90503 F-statistic 36.19601
Durbin-Watson stat 1.999357 Prob(F-statistic) 0.000000

Inverted AR Roots .91
Inverted MA Roots .99 .00+.99i -.00-.99i -.99
2.2. Regression of real manufacturing value-added on principal components (no crisis dummy)

\[ MNFCVA = C(1) + C(2)\times PC1(-4) + C(3)\times PC5 + \]
\[ AR(1)=C(4), MA(4)=C(5), BACKCAST=1997Q2 ] \]

2.3. Regression of real manufacturing value-added on real M2

\[ MNFCVA = C(1) + C(2)\times M2 + C(3)\times M2(-3) + C(4)\times M2(-4) + \]
\[ AR(1)=C(5), MA(4)=C(6), BACKCAST=1997Q2 ] \]

2.4. Regression of real manufacturing value-added on real construction

\[ MNFCVA = C(1) + C(2)\times CONSTR(-1) + C(3)\times CONSTR(-2) + \]

2.5. Regression of real manufacturing value-added on real transportation sales

\[ MNFCVA = C(1) + C(2)\times TRANSPORT(-1) + C(3)\times TRANSPORT(-2) + \]

2.6. Regression of real manufacturing value-added on real average industrial wage

\[ MNFCVA = C(1) + C(2)\times WAGE + C(3)\times WAGE(-1) + \]
\[ AR(1)=C(4), MA(4)=C(5), BACKCAST=1996Q3 ] \]

2.7. Regression of real manufacturing value-added on real retail trade

\[ MNFCVA = C(1) + C(2)\times RTRADE(-1) + C(3)\times RTRADE(-3) + \]
\[ AR(1)=C(4), MA(4)=C(5), BACKCAST=1997Q1 ] \]

2.8. Regression of real manufacturing value-added on real koruna/euro exchange rate

\[ MNFCVA = C(1) + C(2)\times EURATE(-2) + \]

2.9. ARMA PC5 regression

\[ PC5 = C(1) + C(2)\times PC5(-1) + [AR(4)=C(3), MA(7)=C(4), BACKCAST=1997Q2 ] \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real manufacturing value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5.22%</td>
<td>8.57%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>2.1</td>
<td>Yes</td>
<td>5.10%</td>
<td>8.23%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>2.2</td>
<td>No</td>
<td>5.34%</td>
<td>7.62%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>2.3</td>
<td>No</td>
<td>7.57%</td>
<td>7.57%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>Real construction</td>
<td>2.4</td>
<td>No</td>
<td>6.47%</td>
<td>9.59%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>2.5</td>
<td>No</td>
<td>7.94%</td>
<td>6.90%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>Real average industrial wage</td>
<td>2.6</td>
<td>No</td>
<td>2.10%</td>
<td>4.75%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>2.7</td>
<td>No</td>
<td>5.68%</td>
<td>4.64%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>2.8</td>
<td>No</td>
<td>3.88%</td>
<td>5.00%</td>
</tr>
</tbody>
</table>
Table 2.2. Manufacturing Value-Added Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real manufacturing value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>8.57%</td>
</tr>
<tr>
<td>Real manufacturing value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>2.1</td>
<td>Yes</td>
<td>8.70%</td>
</tr>
</tbody>
</table>
3. Utilities

Variables

The dependent variable: real utilities value-added (UTVA), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports (in U.S. dollars)
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Ratio of utilities producer prices to manufacturing producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Utilities Value-Added Regressions

3.1. Regression of real utilities value-added on principal components

\[ UTVA = C(1) + C(2)\ast DUMMY2 + C(3)\ast UTVA(-4) + C(4)\ast PC1 + C(5)\ast PC2 + C(6)\ast PC4 + C(7)\ast PC11(-3) + [MA(7)=C(8),BACKCAST=1997Q1] \]

Dependent Variable: UTVA
Method: Least Squares

Sample (adjusted): 1997Q1 2004Q4
Included observations: 32 after adjustments
Convergence achieved after 18 iterations
Backcast: 1995Q2 1996Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>108.1864</td>
<td>5.602615</td>
<td>19.30998</td>
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<tr>
<td>DUMMY2</td>
<td>74.86159</td>
<td>7.265758</td>
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<tr>
<td>UTVA(-4)</td>
<td>-0.111135</td>
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<td>-2.104029</td>
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</tr>
<tr>
<td>PC1</td>
<td>-3.235384</td>
<td>0.723404</td>
<td>-4.472444</td>
<td>0.0002</td>
</tr>
<tr>
<td>PC2</td>
<td>-5.909512</td>
<td>1.722899</td>
<td>-3.429982</td>
<td>0.0022</td>
</tr>
<tr>
<td>PC4</td>
<td>-4.776075</td>
<td>1.519171</td>
<td>-3.143870</td>
<td>0.0044</td>
</tr>
<tr>
<td>PC11(-3)</td>
<td>-12.84342</td>
<td>4.670479</td>
<td>-2.749916</td>
<td>0.0111</td>
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<tr>
<td>MA(7)</td>
<td>-0.982242</td>
<td>0.034535</td>
<td>-28.44185</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.950845  Mean dependent var 97.20477
Adjusted R-squared 0.936508  S.D. dependent var 25.06938
S.E. of regression 6.316871  Akaike info criterion 6.736643
Sum squared resid 957.6685  Schwarz criterion 7.103077
Log likelihood -99.78629  F-statistic 66.32186
Durbin-Watson stat 1.860705  Prob(F-statistic) 0.000000

Inverted MA Roots 1.00 .62-.78i .62+.78i -.22-.97i
                   -.22+.97i -.90+.43i -.90-.43i
3.2. Regression of real utilities value-added on real utilities production

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times UTVA(-4) + C(4) \times UTILITIES + \]
\[ [MA(7)=C(5),BACKCAST=1997Q1] \]

3.3. Regression of real utilities value-added on real manufacturing production

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times UTVA(-4) + C(4) \times MNFC + C(5) \times MNFC(-2) + C(6) \times MNFC(-3) + [AR(1)=C(7),MA(7)=C(8),BACKCAST=1997Q2] \]

3.4. Regression of real utilities value-added on industrial confidence index

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times UTVA(-4) + C(4) \times INDC + [AR(1)=C(5),MA(7)=C(6),BACKCAST=1997Q2] \]

3.5. Regression of real utilities value-added on real transportation sales

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times UTVA(-4) + C(4) \times TRANSPORT + C(5) \times TRANSPORT(-2) + [MA(7)=C(6),BACKCAST=1997Q1] \]

3.6. Regression of real utilities value-added on real retail trade

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times UTVA(-4) + C(4) \times RTRADE + [MA(7)=C(5),BACKCAST=1997Q1] \]

3.7. Regression of real utilities value-added on real M2

\[ UTVA = C(1) + C(2) \times DUMMY2 + C(3) \times M2(-1) + [AR(1)=C(4),MA(7)=C(5),BACKCAST=1997Q1] \]

3.8. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \times PC1(-1) + [AR(1)=C(3),MA(4)=C(4),BACKCAST=1996Q3] \]

3.9. ARMA PC2 regression

\[ PC2 = C(1) + C(2) \times PC2(-1) + [MA(4)=C(3),MA(5)=C(4),BACKCAST=1996Q2] \]

3.10. ARMA PC4 regression

\[ PC4 = C(1) + C(2) \times PC4(-1) + [AR(4)=C(3),MA(4)=C(4),BACKCAST=1997Q2] \]
Table 3.1. Utilities Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real utilities value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.76%</td>
<td>11.18%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>3.1</td>
<td>No</td>
<td>6.89%</td>
<td>11.41%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>Real utilities production</td>
<td>3.2</td>
<td>No</td>
<td>-3.60%</td>
<td>-0.95%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>Real manufacturing production</td>
<td>3.3</td>
<td>No</td>
<td>9.26%</td>
<td>22.87%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>Industrial confidence index</td>
<td>3.4</td>
<td>No</td>
<td>9.50%</td>
<td>10.17%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>3.5</td>
<td>No</td>
<td>4.95%</td>
<td>8.79%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>3.6</td>
<td>No</td>
<td>-6.20%</td>
<td>-0.16%</td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>3.7</td>
<td>No</td>
<td>2.32%</td>
<td>-0.85%</td>
</tr>
<tr>
<td>Independent variable</td>
<td>Official or forecast</td>
<td>Dependent variables</td>
<td>Regression number</td>
<td>Crisis dummies</td>
<td>2004 IV</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.18%</td>
<td></td>
</tr>
<tr>
<td>Real utilities value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>3.1</td>
<td>No</td>
<td>11.39%</td>
<td></td>
</tr>
</tbody>
</table>
4. Construction

Variables

The dependent variable: real construction value-added (CONSTRVA), year-over-year index

The special variable: real construction (CONSTR), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports (in U.S. dollars)
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Ratio of industrial producer prices to construction prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Construction Value-Added Regressions

4.1. Regression of real construction value-added on real construction and principal components

\[
CONSTRVA = C(1) + C(2) \times CONSTR + C(3) \times CONSTR(-1) + C(4) \times PC4 + C(5) \times PC11 + C(6) \times PC2(-1) + \{AR(4)=C(7), MA(8)=C(8), BACKCAST=1997:2\}
\]

Dependent Variable: CONSTRVA
Method: Least Squares

Sample(adjusted): 1997:2 2004:4
Included observations: 31 after adjusting endpoints
Convergence achieved after 13 iterations
Backcast: 1995:2 1997:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>71.34910</td>
<td>16.63358</td>
<td>4.289461</td>
<td>0.0003</td>
</tr>
<tr>
<td>CONSTR</td>
<td>0.704101</td>
<td>0.243929</td>
<td>2.886495</td>
<td>0.0083</td>
</tr>
<tr>
<td>CONSTR(-1)</td>
<td>-0.458445</td>
<td>0.213477</td>
<td>-2.147513</td>
<td>0.0425</td>
</tr>
<tr>
<td>PC4</td>
<td>5.901554</td>
<td>1.256229</td>
<td>4.697832</td>
<td>0.0001</td>
</tr>
<tr>
<td>PC11</td>
<td>5.251619</td>
<td>2.501370</td>
<td>2.099498</td>
<td>0.0469</td>
</tr>
<tr>
<td>PC2(-1)</td>
<td>-2.564884</td>
<td>1.161803</td>
<td>-2.207675</td>
<td>0.0375</td>
</tr>
<tr>
<td>AR(4)</td>
<td>-0.423448</td>
<td>0.132091</td>
<td>-3.205723</td>
<td>0.0039</td>
</tr>
<tr>
<td>MA(8)</td>
<td>0.933311</td>
<td>0.022715</td>
<td>41.08849</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.891870  Mean dependent var 95.88910
Adjusted R-squared 0.858961  S.D. dependent var 11.01050
S.E. of regression 4.135014  Akaike info criterion 5.894495
Sum squared resid 393.2619  Schwarz criterion 6.264556
Log likelihood -83.36467  F-statistic 27.10094
Durbin-Watson stat 1.787632  Prob(F-statistic) 0.000000

Inverted AR Roots 0.57+.57i 0.57+.57i -0.57 -.57i -0.57 -.57i
Inverted MA Roots 0.92+.38i 0.92 -.38i 0.38 -.92i 0.38+.92i
-0.38+.92i -0.38 -.92i -0.92 -.38i -0.92+.38i
4.2. Regression of real construction value-added on real construction

\[ \text{CONSTRVA} = C(1) + C(2) \times \text{CONSTR} + C(3) \times \text{CONSTR}(-1) + C(4) \times \text{CONSTR}(-4) + \]
\[ \{ \text{AR}(4) = C(5), \text{MA}(8) = C(6), \text{BACKCAST} = 1998:1 \} \]

4.3. Regression of real construction value-added on real industrial production

\[ \text{CONSTRVA} = C(1) + C(2) \times \text{IND}(-4) + \]
\[ \{ \text{AR}(1) = C(3), \text{AR}(4) = C(4), \text{MA}(5) = C(5), \text{BACKCAST} = 1998:1 \} \]

4.4. Regression of real construction value-added on real M2

\[ \text{CONSTRVA} = C(1) + C(2) \times \text{M2} + \]
\[ \{ \text{AR}(1) = C(3), \text{AR}(4) = C(4), \text{MA}(8) = C(5), \text{BACKCAST} = 1997:1 \} \]

4.5. Regression of real construction value-added on real interest rate

\[ \text{CONSTRVA} = C(1) + C(2) \times \text{RIR}(-3) + \{ \text{AR}(4) = C(3), \text{MA}(8) = C(4), \text{BACKCAST} = 1997:4 \} \]

4.6. Regression of real construction value-added on real transportation

\[ \text{CONSTRVA} = C(1) + C(2) \times \text{TRANSPORT}(-2) + C(3) \times \text{TRANSPORT}(-3) + \]
\[ \{ \text{AR}(1) = C(4), \text{AR}(4) = C(5), \text{MA}(8) = C(6), \text{BACKCAST} = 1997:4 \} \]

4.7. ARMA regression of real construction

\[ \text{CONSTR} = C(1) + C(2) \times \text{CONSTR}(-1) + \]
\[ \{ \text{MA}(4) = C(3), \text{MA}(7) = C(4), \text{BACKCAST} = 1996:2 \} \]

4.8. ARMA PC4 regression

\[ \text{PC4} = C(1) + C(2) \times \text{PC4}(-1) + \{ \text{MA}(7) = C(3), \text{BACKCAST} = 1996:2 \} \]

4.9. ARMA PC11 regression

\[ \text{PC11} = C(1) + C(2) \times \text{PC11}(-1) + C(3) \times \text{PC11}(-2) + \{ \text{MA}(5) = C(4), \text{BACKCAST} = 1996:3 \} \]
Table 4.1. Construction Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real construction value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-6.99%</td>
<td>-3.24%</td>
</tr>
<tr>
<td>Real construction</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.40%</td>
<td>4.67%</td>
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<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction and PCs</td>
<td>4.1</td>
<td>No</td>
<td>-6.58%</td>
<td>-3.46%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction</td>
<td>4.2</td>
<td>No</td>
<td>-6.41%</td>
<td>0.74%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>4.3</td>
<td>No</td>
<td>-2.55%</td>
<td>0.51%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>4.4</td>
<td>No</td>
<td>-2.91%</td>
<td>-4.66%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real interest rate</td>
<td>4.5</td>
<td>No</td>
<td>-10.43%</td>
<td>4.34%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>4.6</td>
<td>No</td>
<td>-5.23%</td>
<td>4.88%</td>
</tr>
</tbody>
</table>
Table 4.2. Construction Value-Added Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real construction value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-3.24%</td>
</tr>
<tr>
<td>Real construction value-added</td>
<td>Forecast</td>
<td>Real construction and PCs</td>
<td>4.1</td>
<td>No</td>
<td>-1.90%</td>
</tr>
</tbody>
</table>
5. Trade

Variables

The dependent variable: real retail and wholesale trade value-added (TRADEVA), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real retail trade
- Real construction
- Real transportation sales
- Ratio of exports to imports (in U.S. dollars)
- Ratio of government budget expenditures to revenues
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Trade confidence index
5.1. Regression of real trade value-added on principal components

\[\text{TRADEVA} = C(1) + C(2) \times PC2 + C(3) \times PC4 + C(4) \times PC1(-1) + C(5) \times PC9(-1) + C(6) \times PC2(-2) + C(7) \times PC1(-4) + [MA(4) = C(8), \text{BACKCAST}=1997Q1]\]

Dependent Variable: TRADEVA
Method: Least Squares

Sample (adjusted): 1997Q1 2004Q4
Included observations: 32 after adjustments
Convergence achieved after 60 iterations
Backcast: 1996Q1 1996Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>104.5849</td>
<td>0.442083</td>
<td>236.5729</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC2</td>
<td>1.976819</td>
<td>0.784165</td>
<td>2.520923</td>
<td>0.0188</td>
</tr>
<tr>
<td>PC4</td>
<td>3.109749</td>
<td>0.974075</td>
<td>3.192515</td>
<td>0.0039</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>-0.627696</td>
<td>0.491725</td>
<td>-1.276518</td>
<td>0.2140</td>
</tr>
<tr>
<td>PC9(-1)</td>
<td>3.095440</td>
<td>1.070828</td>
<td>2.890698</td>
<td>0.0080</td>
</tr>
<tr>
<td>PC2(-2)</td>
<td>2.180911</td>
<td>0.721874</td>
<td>3.021182</td>
<td>0.0059</td>
</tr>
<tr>
<td>PC1(-4)</td>
<td>1.484309</td>
<td>0.574640</td>
<td>2.583023</td>
<td>0.0163</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.973153</td>
<td>0.027995</td>
<td>-34.76175</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.869880  Mean dependent var 106.4894
Adjusted R-squared 0.831928  S.D. dependent var 8.870616
S.E. of regression 3.636649  Akaike info criterion 5.632320
Sum squared resid 317.4052  Schwarz criterion 5.998754
Log likelihood -82.11713  F-statistic 22.92069
Durbin-Watson stat 2.100190  Prob(F-statistic) 0.000000

Inverted MA Roots .99 .00+.99i -.00-.99i -.99
5.2. Regression of real trade value-added on principal components (a crisis dummy variable is included)

\[ \text{TRADEVA} = C(1) + C(2) \times \text{DUMMY1} + C(3) \times \text{PC2} + C(4) \times \text{PC4} + C(5) \times \text{PC9}(-1) + \\
C(6) \times \text{PC2}(-2) + C(7) \times \text{PC1}(-4) + [\text{MA}(4) = C(8), \text{BACKCAST} = 1997Q1] \]

5.3. Regression of real trade value-added on real retail trade

\[ \text{TRADEVA} = C(1) + C(2) \times \text{RTRADE}(-2) + C(3) \times \text{RTRADE}(-4) + \\
[\text{AR}(1) = C(4), \text{MA}(4) = C(5), \text{BACKCAST} = 1997Q2] \]

5.4. Regression of real trade value-added on real industrial production

\[ \text{TRADEVA} = C(1) + C(2) \times \text{IND}(-4) + [\text{AR}(1) = C(3), \text{MA}(4) = C(4), \text{BACKCAST} = 1997Q2] \]

5.5. Regression of real trade value-added on the ratio of merchandise exports to imports

\[ \text{TRADEVA} = C(1) + C(2) \times \text{EXPIMP}(-1) + C(3) \times \text{EXPIMP}(-2) + \\
C(4) \times \text{DUMMYEXPIMP}(-2) + [\text{AR}(1) = C(5), \text{MA}(4) = C(6), \text{BACKCAST} = 1996Q4] \]

5.6. Regression of real trade value-added on the real koruna/euro exchange rate

\[ \text{TRADEVA} = C(1) + C(2) \times \text{EURATE} + C(3) \times \text{EURATE}(-2) + C(4) \times \text{DUMMYEURATE}(-2) + \\
[\text{AR}(1) = C(5), \text{MA}(4) = C(6), \text{BACKCAST} = 1996Q4] \]

5.7. Regression of real trade value-added on the trade confidence index

\[ \text{TRADEVA} = C(1) + C(2) \times \text{TRADEC}(-2) + \\
[\text{AR}(1) = C(3), \text{MA}(4) = C(4), \text{BACKCAST} = 1996Q4] \]

5.8. Regression of real trade value-added on real M2

\[ \text{TRADEVA} = C(1) + C(2) \times \text{M2}(-2) + C(3) \times \text{M2}(-3) + C(4) \times \text{DUMMYM2}(-3) + \\
[\text{AR}(1) = C(5), \text{MA}(4) = C(6), \text{BACKCAST} = 1997Q1] \]

5.9. ARMA PC2 regression

\[ \text{PC2} = C(1) + C(2) \times \text{DUMMY1} + C(3) \times \text{PC2}(-1) + \\
[\text{AR}(3) = C(4), \text{AR}(4) = C(5), \text{MA}(4) = C(6), \text{BACKCAST} = 1997Q2] \]
5.10. ARMA PC4 regression

\[ PC4 = C(1) + C(2) \times PC4(-1) + [AR(3)=C(3), MA(7)=C(4), BACKCAST=1997Q1] \]
Table 5.1. Trade Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real trade value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>5.19%</td>
<td>4.00%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>5.1</td>
<td>No</td>
<td>6.11%</td>
<td>2.88%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>5.2</td>
<td>Yes</td>
<td>7.27%</td>
<td>1.71%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>5.3</td>
<td>No</td>
<td>-1.71%</td>
<td>-4.93%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>5.4</td>
<td>No</td>
<td>-0.38%</td>
<td>-5.64%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Ratio of merchandise exports to imports</td>
<td>5.5</td>
<td>Yes</td>
<td>3.23%</td>
<td>-7.06%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>5.6</td>
<td>Yes</td>
<td>8.90%</td>
<td>2.31%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Trade confidence index</td>
<td>5.7</td>
<td>No</td>
<td>4.72%</td>
<td>-7.58%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>5.8</td>
<td>Yes</td>
<td>2.72%</td>
<td>-2.72%</td>
</tr>
</tbody>
</table>
Table 5.2. Trade Value-Added Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real trade value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.00%</td>
</tr>
<tr>
<td>Real trade value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>5.1</td>
<td>No</td>
<td>2.90%</td>
</tr>
</tbody>
</table>
6. Transportation

Variables

The dependent variable: real transportation and communication value-added (TRANSPVA), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports (in U.S. dollars)
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to transportation prices
- Ratio of industrial producer prices to transportation prices
- Ratio of construction prices to transportation prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Transportation Value-Added Regressions

6.1. Regression of real transportation value-added on principal components

\[ \text{TRANSPVA} = C(1) + C(2) \times \text{TRANSPVA}(-4) + C(3) \times \text{PC8} + C(4) \times \text{PC2}(-1) + C(5) \times \text{PC3}(-1) + C(6) \times \text{PC4}(-1) + [\text{MA}(8)=C(7), \text{BACKCAST}=1997Q1] \]

Dependent Variable: TRANSPVA
Method: Least Squares

Sample (adjusted): 1997Q1 2004Q4
Included observations: 32 after adjustments
Convergence achieved after 18 iterations
Backcast: 1995Q1 1996Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>144.8984</td>
<td>13.92930</td>
<td>10.40242</td>
<td>0.0000</td>
</tr>
<tr>
<td>TRANSPVA(-4)</td>
<td>-0.402681</td>
<td>0.137878</td>
<td>-2.920570</td>
<td>0.0073</td>
</tr>
<tr>
<td>PC8</td>
<td>6.730055</td>
<td>1.630951</td>
<td>4.126460</td>
<td>0.0004</td>
</tr>
<tr>
<td>PC2(-1)</td>
<td>-0.839007</td>
<td>0.692532</td>
<td>-1.211507</td>
<td>0.2370</td>
</tr>
<tr>
<td>PC3(-1)</td>
<td>1.250734</td>
<td>1.126124</td>
<td>1.110654</td>
<td>0.2773</td>
</tr>
<tr>
<td>PC4(-1)</td>
<td>-3.721723</td>
<td>1.021882</td>
<td>-3.642027</td>
<td>0.0012</td>
</tr>
<tr>
<td>MA(8)</td>
<td>-0.948103</td>
<td>0.022778</td>
<td>-41.62341</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.809956  Mean dependent var 100.8175
Adjusted R-squared 0.764345  S.D. dependent var 7.119225
S.E. of regression 3.455979  Akaike info criterion 5.508728
Sum squared resid 298.5947  Schwarz criterion 5.829358
Log likelihood -81.13965  F-statistic 17.75804
Durbin-Watson stat 2.119949  Prob(F-statistic) 0.000000

<table>
<thead>
<tr>
<th>Inverted MA Roots</th>
<th>.99</th>
<th>.70-.70i</th>
<th>.70+.70i</th>
<th>.00+.99i</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.00-.99i</td>
<td>-1.70-.70i</td>
<td>-.70+.70i</td>
<td>-.99</td>
</tr>
</tbody>
</table>
6.2. Regression of real transportation value-added on real utilities production

\[ TRANSPVA = C(1) + C(2) \times UTILITIES + C(3) \times UTILITIES(-3) + \]
\[ [AR(1)=C(4),MA(8)=C(5),BACKCAST=1997:1] \]

6.3. Regression of real transportation value-added on real transportation sales

\[ TRANSPVA = C(1) + C(2) \times TRANSPORT(-3) + \]
\[ [AR(1)=C(3),MA(4)=C(4),BACKCAST=1997Q1] \]

6.4. Regression of real transportation value-added on the real koruna/euro exchange rate

\[ TRANSPVA = C(1) + C(2) \times TRANSPVA(-4) + C(3) \times EURATE + \]
\[ [MA(8)=C(4),BACKCAST=1997Q1] \]

6.5. Regression of real transportation value-added on the ratio of government budget expenditures to revenues

\[ TRANSPVA = C(1) + C(2) \times TRANSPVA(-4) + C(3) \times EXPREV + C(4) \times EXPREV(-3) + \]
\[ [AR(1)=C(5),MA(8)=C(6),BACKCAST=1997Q2] \]

6.6. Regression of real transportation value-added on the ratio of consumer prices to transportation prices

\[ TRANSPVA = C(1) + C(2) \times TRANSPVA(-1) + C(3) \times TRANSPVA(-4) + C(4) \times CPITRPR(-1) + \]
\[ [MA(8)=C(5),BACKCAST=1997Q1] \]

6.7. Regression of real transportation value-added on the real interest rate

\[ TRANSPVA = C(1) + C(2) \times TRANSPVA(-1) + C(3) \times TRANSPVA(-4) + C(4) \times RIR(-2) + \]
\[ [MA(8)=C(5),BACKCAST=1997Q1] \]

6.8. ARMA PC8 regression

\[ PC8 = C(1) + C(2) \times PC8(-1) + C(3) \times DUMMYPC8(-1) + \]
\[ [MA(5)=C(4),BACKCAST=1996Q2] \]
Table 6.1. Transportation Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real transportation value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3.07%</td>
<td>1.76%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>6.1</td>
<td>No</td>
<td>3.01%</td>
<td>1.00%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Real utilities production</td>
<td>6.2</td>
<td>No</td>
<td>2.88%</td>
<td>4.78%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>6.3</td>
<td>No</td>
<td>3.91%</td>
<td>4.38%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Real euro/dollar exchange rate</td>
<td>6.4</td>
<td>No</td>
<td>8.68%</td>
<td>6.86%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Ratio of government budget expenditures to revenues</td>
<td>6.5</td>
<td>No</td>
<td>5.32%</td>
<td>0.67%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Ratio of consumer prices to transportation prices</td>
<td>6.6</td>
<td>No</td>
<td>4.51%</td>
<td>3.51%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>Real interest rate</td>
<td>6.7</td>
<td>No</td>
<td>8.17%</td>
<td>7.92%</td>
</tr>
</tbody>
</table>
Table 6.2. Transportation Value-Added Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real transportation value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1.76%</td>
</tr>
<tr>
<td>Real transportation value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>6.1</td>
<td>No</td>
<td>2.33%</td>
</tr>
</tbody>
</table>
7. Real Estate

Variables

The dependent variable: real real estate value-added (REALESTVA), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
### 7.1. Regression of real real estate value-added on principal components

\[
\text{REALESTVA} = C(1) + C(2) \times \text{REALESTVA}(-1) + C(3) \times \text{REALESTVA}(-3) + C(4) \times \text{PC6}(-1) + C(5) \times \text{PC5}(-3) + [\text{AR}(1)=C(6), \text{AR}(2)=C(7), \text{MA}(5)=C(8), \text{BACKCAST}=1997:2]
\]

Dependent Variable: REALESTVA  
Method: Least Squares

Sample(adjusted): 1997:2 2004:4  
Included observations: 31 after adjusting endpoints  
Convergence achieved after 20 iterations  
Backcast: 1996:1 1997:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>56.19649</td>
<td>4.820999</td>
<td>11.65661</td>
<td>0.0000</td>
</tr>
<tr>
<td>REALESTVA(-1)</td>
<td>0.983360</td>
<td>0.042526</td>
<td>23.12384</td>
<td>0.0000</td>
</tr>
<tr>
<td>REALESTVA(-3)</td>
<td>-0.521197</td>
<td>0.026935</td>
<td>-19.34994</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC6(-1)</td>
<td>2.475872</td>
<td>1.008180</td>
<td>2.455783</td>
<td>0.0220</td>
</tr>
<tr>
<td>PC5(-3)</td>
<td>1.242824</td>
<td>0.710194</td>
<td>1.749794</td>
<td>0.0935</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.284115</td>
<td>0.107103</td>
<td>-2.652730</td>
<td>0.0142</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.792488</td>
<td>0.131992</td>
<td>-6.004041</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(5)</td>
<td>0.976115</td>
<td>0.042243</td>
<td>23.10708</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.854797  
Mean dependent var: 103.7751  
Adjusted R-squared: 0.810605  
S.D. dependent var: 7.854728  
S.E. of regression: 3.418341  
Akaike info criterion: 5.513824  
Schwarz criterion: 5.883885  
Log likelihood: -77.46427  
F-statistic: 19.34273  
Prob(F-statistic): 0.000000

Inverted AR Roots: -0.14+.88i, -0.14-.88i  
Inverted MA Roots: 0.81-.58i, 0.81+.58i, -0.31+.95i, -0.31-.95i, -1.00
7.2. Regression of real real estate value-added on real utilities production

\[ REALESTVA = C(1) + C(2) \times REALESTVA(-1) + C(3) \times REALESTVA(-3) + C(4) \times UTILITIES(-1) + [AR(1)=C(5),AR(2)=C(6),MA(5)=C(7),BACKCAST=1997:2] \]

7.3. Regression of real real estate value-added on real M2

\[ REALESTVA = C(1) + C(2) \times REALESTVA(-1) + C(3) \times REALESTVA(-3) + C(4) \times M2(-2) + C(5) \times M2(-4) + [AR(1)=C(6),AR(2)=C(7),MA(5)=C(8),BACKCAST=1997:3] \]

7.4. Regression of real real estate value-added on the real interest rate

\[ REALESTVA = C(1) + C(2) \times REALESTVA(-1) + C(3) \times REALESTVA(-3) + C(4) \times RIR + C(5) \times RIR(-4) + [AR(1)=C(6),AR(2)=C(7),MA(5)=C(8),BACKCAST=1997:3] \]

7.5. Regression of real real estate value-added on the ratio of government budget expenditures to revenues

\[ REALESTVA = C(1) + C(2) \times REALESTVA(-1) + C(3) \times REALESTVA(-3) + C(4) \times EXPREV(-1) + [AR(1)=C(5),AR(2)=C(6),MA(5)=C(7),BACKCAST=1997:2] \]

7.6. Regression of real real estate value-added on the koruna/euro exchange rate

\[ REALESTVA = C(1) + C(2) \times REALESTVA(-1) + C(3) \times REALESTVA(-3) + C(4) \times EURATE(-4) + [AR(1)=C(5),AR(2)=C(6),MA(5)=C(7),BACKCAST=1997:3] \]

7.7. Regression of real real estate value-added on the unemployment rate

\[ REALESTVA = C(1) + C(2) \times REALESTVA(-1) + C(3) \times REALESTVA(-3) + C(4) \times UNEMPL + C(5) \times UNEMPL(-4) + [AR(1)=C(6),AR(2)=C(7),MA(5)=C(8),BACKCAST=1997:3] \]
Table 7.1. Real Estate Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real real estate value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.04%</td>
<td>-2.14%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>7.1</td>
<td>No</td>
<td>-0.76%</td>
<td>-2.14%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>Real utilities production</td>
<td>7.2</td>
<td>No</td>
<td>1.72%</td>
<td>-0.32%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>Real M2</td>
<td>7.3</td>
<td>No</td>
<td>-1.78%</td>
<td>-1.81%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>Real interest rate</td>
<td>7.4</td>
<td>No</td>
<td>0.72%</td>
<td>-0.09%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>Ratio of government budget expenditures to revenues</td>
<td>7.5</td>
<td>No</td>
<td>2.90%</td>
<td>5.81%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>7.6</td>
<td>No</td>
<td>0.79%</td>
<td>0.73%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>Unemployment rate</td>
<td>7.7</td>
<td>No</td>
<td>3.38%</td>
<td>-0.25%</td>
</tr>
</tbody>
</table>
Table 7.2. Real Estate Value-Added Growth Rates. Official Figure and Out-of-Sample Forecast Based on Official Independent Variables (the sample is reduced by one quarter)

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real real estate value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-2.14%</td>
</tr>
<tr>
<td>Real real estate value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>7.1</td>
<td>Yes</td>
<td>-0.68%</td>
</tr>
</tbody>
</table>
8. Other Sectors

Variables

The dependent variable: real other sector value-added (OTHVA), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Other Sector Value-Added Regressions

8.1. Regression of real other sector value-added on principal components

\[ OTHVA = C(1) + C(2) \times OTHVA(-1) + C(3) \times PC6 + C(4) \times PC3(-1) + C(5) \times PC6(-1) + C(6) \times PC3(-4) + C(7) \times PC5(-4) + C(8) \times PC6(-4) + [MA(6)=C(9),BACKCAST=1997Q1]\]

Dependent Variable: OTHVA
Method: Least Squares

Sample (adjusted): 1997Q1 2004Q4
Included observations: 32 after adjustments
Convergence achieved after 22 iterations
Backcast: 1995Q3 1996Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>77.74213</td>
<td>10.41922</td>
<td>7.461415</td>
<td>0.0000</td>
</tr>
<tr>
<td>OTHVA(-1)</td>
<td>0.226639</td>
<td>0.104104</td>
<td>2.177032</td>
<td>0.0400</td>
</tr>
<tr>
<td>PC6</td>
<td>1.152220</td>
<td>0.275853</td>
<td>4.176927</td>
<td>0.0004</td>
</tr>
<tr>
<td>PC3(-1)</td>
<td>-1.754587</td>
<td>0.241675</td>
<td>-7.260117</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC6(-1)</td>
<td>-0.872540</td>
<td>0.416881</td>
<td>-2.093021</td>
<td>0.0476</td>
</tr>
<tr>
<td>PC3(-4)</td>
<td>0.841378</td>
<td>0.321857</td>
<td>2.614138</td>
<td>0.0155</td>
</tr>
<tr>
<td>PC5(-4)</td>
<td>1.456347</td>
<td>0.286290</td>
<td>5.086959</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC6(-4)</td>
<td>-1.569571</td>
<td>0.328871</td>
<td>-4.772601</td>
<td>0.0001</td>
</tr>
<tr>
<td>MA(6)</td>
<td>-0.982310</td>
<td>0.018483</td>
<td>-53.14631</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.961143
Adjusted R-squared 0.947628
S.E. of regression 1.064193
S.D. dependent var 4.650193
Akaike info criterion 3.194569
Schwarz criterion 3.606807
Log likelihood -42.11311
F-statistic 71.11495
Prob(F-statistic) 0.000000

Inverted MA Roots

\n
\begin{align*}
\text{Inverted MA Roots} & \quad 1.00 \quad .50+.86i \quad .50-.86i \quad -.50+.86i \\
 & \quad -.50-.86i \quad -1.00
\end{align*}\n
484
8.2. Regression of real other sector value-added on real retail trade

\[\text{OTHVA} = C(1) + C(2)\times \text{OTHVA}(-1) + C(3)\times \text{OTHVA}(-2) + C(4)\times \text{RTRADE}(-1) + C(5)\times \text{RTRADE}(-2) + C(6)\times \text{RTRADE}(-3) + C(7)\times \text{RTRADE}(-4) + [\text{MA(6)}=C(8), \text{BACKCAST}=1997Q1]\]

8.3. Regression of real other sector value-added on real average industrial wage

\[\text{OTHVA} = C(1) + C(2)\times \text{OTHVA}(-1) + C(3)\times \text{WAGE} + C(4)\times \text{WAGE}(-4) + [\text{MA(6)}=C(5), \text{BACKCAST}=1997Q1]\]

8.4. Regression of real other sector value-added on the ratio of government budget expenditures to revenues

\[\text{OTHVA} = C(1) + C(2)\times \text{OTHVA}(-1) + C(3)\times \text{EXPREV}(-2) + [\text{MA(6)}=C(4), \text{BACKCAST}=1996Q3]\]

8.5. Regression of real other sector value-added on real industrial production

\[\text{OTHVA} = C(1) + C(2)\times \text{OTHVA}(-1) + C(3)\times \text{IND}(-2) + [\text{MA(6)}=C(4), \text{BACKCAST}=1996Q3]\]

8.6. Regression of real other sector value-added on the real koruna/euro exchange rate

\[\text{OTHVA} = C(1) + C(2)\times \text{OTHVA}(-1) + C(3)\times \text{EURATE}(-2) + [\text{MA(6)}=C(4), \text{BACKCAST}=1996Q3]\]

8.7. Regression of real other sector value-added on the real interest rate

\[\text{OTHVA} = C(1) + C(2)\times \text{OTHVA}(-1) + C(3)\times \text{RIR}(-1) + C(4)\times \text{RIR}(-4) + [\text{MA(6)}=C(5), \text{BACKCAST}=1997Q1]\]

8.8. ARMA PC6 regression

\[\text{PC6} = C(1) + C(2)\times \text{PC6}(-1) + [\text{MA(7)}=C(3), \text{BACKCAST}=1996Q2]\]
Table 8.1. Other Sector Value-Added Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other sector value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.68%</td>
<td>2.71%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.1</td>
<td>No</td>
<td>3.85%</td>
<td>2.84%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>8.2</td>
<td>No</td>
<td>3.06%</td>
<td>4.51%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>Real average industrial wage</td>
<td>8.3</td>
<td>No</td>
<td>2.23%</td>
<td>3.21%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>Ratio of government budget expenditures to revenues</td>
<td>8.4</td>
<td>No</td>
<td>1.57%</td>
<td>0.86%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>8.5</td>
<td>No</td>
<td>2.94%</td>
<td>4.79%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>8.6</td>
<td>No</td>
<td>1.48%</td>
<td>1.64%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>Real interest rate</td>
<td>8.7</td>
<td>No</td>
<td>2.74%</td>
<td>3.53%</td>
</tr>
</tbody>
</table>
Table 8.2. Other Sector Value-Added Growth Rates. Official Figure and Out-of-Sample Forecast Based on Official Independent Variables (the sample is reduced by one quarter)

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real other sector value-added</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2.71%</td>
</tr>
<tr>
<td>Real other sector value-added</td>
<td>Forecast</td>
<td>PCs</td>
<td>8.1</td>
<td>Yes</td>
<td>4.10%</td>
</tr>
</tbody>
</table>
9. Net Taxes on Goods and Imports

Variables

The dependent variable: real net taxes on products and imports (TAX), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports (in U.S. dollars)
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Net Tax Regressions

9.1. Regression of real net taxes on products and imports on principal components

\[ \text{TAX} = C(1) + C(2) \times \text{PC1} + C(3) \times \text{PC8} + \\
[AR(1)=C(4),MA(4)=C(5),\text{BACKCAST}=1996Q2] \]

Dependent Variable: TAX
Method: Least Squares

Sample (adjusted): 1996Q2 2004Q4
Included observations: 35 after adjustments
Convergence achieved after 13 iterations
Backcast: 1995Q2 1996Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>102.5401</td>
<td>0.504857</td>
<td>203.1071</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>1.644107</td>
<td>0.350334</td>
<td>4.692973</td>
<td>0.0001</td>
</tr>
<tr>
<td>PC8</td>
<td>-0.970274</td>
<td>0.878867</td>
<td>-1.104005</td>
<td>0.2784</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.651975</td>
<td>0.124457</td>
<td>5.238537</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.989900</td>
<td>0.043625</td>
<td>-22.69121</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared          0.831475  Mean dependent var 104.0840
Adjusted R-squared 0.809005  S.D. dependent var 5.852907
S.E. of regression 2.557897  Akaike info criterion 4.847811
Sum squared resid 196.2851  Schwarz criterion 5.070004
Log likelihood    -79.83670  F-statistic 37.00370
Durbin-Watson stat 1.808297  Prob(F-statistic) 0.000000

Inverted AR Roots .65
Inverted MA Roots  1.00  -0.00 +1.00i  -0.00 -1.00i  -1.00
9.2. Regression of real net taxes on products and imports on real retail trade

\[ \text{TAX} = C(1) + C(2) * \text{RTRADE} + [\text{AR}(1)=C(3), \text{MA}(4)=C(4), \text{BACKCAST}=1996\text{Q2}] \]

9.3. Regression of real net taxes on products and imports on real M2

\[ \text{TAX} = C(1) + C(2) * \text{M2} + C(3) * \text{M2}(-2) + \\
[\text{AR}(1)=C(4), \text{MA}(4)=C(5), \text{BACKCAST}=1996\text{Q4}] \]

9.4. Regression of real net taxes on products and imports on real average industrial wage

\[ \text{TAX} = C(1) + C(2) * \text{WAGE} + [\text{AR}(1)=C(3), \text{MA}(4)=C(4), \text{BACKCAST}=1996\text{Q2}] \]

9.5. Regression of real net taxes on products and imports on real industrial production

\[ \text{TAX} = C(1) + C(2) * \text{IND} + C(3) * \text{IND}(-2) + \\
[\text{AR}(1)=C(4), \text{AR}(2)=C(5), \text{MA}(4)=C(6), \text{BACKCAST}=1997\text{Q1}] \]

9.6. Regression of real net taxes on products and imports on real transportation sales

\[ \text{TAX} = C(1) + C(2) * \text{TRANSPORT} + [\text{AR}(1)=C(3), \text{MA}(4)=C(4), \text{BACKCAST}=1996\text{Q2}] \]

9.7. Regression of real net taxes on products and imports on the ratio of government budget expenditures to revenues

\[ \text{TAX} = C(1) + C(2) * \text{EXPREV} + [\text{AR}(1)=C(3), \text{MA}(4)=C(4), \text{BACKCAST}=1996\text{Q2}] \]

9.8. ARMA PC1 regression

\[ \text{PC1} = C(1) + C(2) * \text{PC1}(-1) + C(3) * \text{PC1}(-2) + [\text{MA}(1)=C(4), \text{BACKCAST}=1996\text{Q3}] \]

9.9 ARMA PC8 regression

\[ \text{PC8} = C(1) + C(2) * \text{DUMMY1} + C(3) * \text{PC8}(-1) + [\text{MA}(4)=C(4), \text{BACKCAST}=1996\text{Q2}] \]
Table 9.1. Net Taxes on Products and Imports Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real net taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.54%</td>
<td>6.88%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>9.1</td>
<td>No</td>
<td>7.53%</td>
<td>6.86%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>9.2</td>
<td>No</td>
<td>6.52%</td>
<td>5.56%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>Real M2</td>
<td>9.3</td>
<td>No</td>
<td>9.14%</td>
<td>9.74%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>Real average industrial wage</td>
<td>9.4</td>
<td>No</td>
<td>8.41%</td>
<td>6.44%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>9.5</td>
<td>No</td>
<td>8.19%</td>
<td>9.14%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>9.6</td>
<td>No</td>
<td>7.14%</td>
<td>6.08%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>Ratio of government budget expenditures to revenues</td>
<td>9.7</td>
<td>No</td>
<td>7.24%</td>
<td>9.50%</td>
</tr>
</tbody>
</table>
Table 9.2. Net Taxes on Products and Imports Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real net taxes on products and imports</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>6.88%</td>
</tr>
<tr>
<td>Real net taxes on products and imports</td>
<td>Forecast</td>
<td>PCs</td>
<td>9.1</td>
<td>No</td>
<td>6.50%</td>
</tr>
</tbody>
</table>
10. Household Consumption

Variables

The dependent variable: real household consumption (HOUS), year-over-year index

The special variable: real retail trade (RTRADE), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Ratio of merchandise exports to imports
- Ratio of government budget expenditures to revenues
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Trade confidence index
Real Household Consumption Regressions

10.1. Regression of real household consumption on real retail trade and principal components

\[ HOUS = C(1) + C(2) \cdot RTRADE + C(3) \cdot PC1 + C(4) \cdot PC2 + C(5) \cdot PC5 + C(6) \cdot PC2(-1) \\
+ C(7) \cdot DUMMYPC2(-1) + [MA(5)=C(8),BACKCAST=1996Q2] \]

Dependent Variable: HOUS
Method: Least Squares

Sample (adjusted): 1996Q2 2004Q4
Included observations: 35 after adjustments
Convergence achieved after 13 iterations
Backcast: 1995Q1 1996Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>69.68641</td>
<td>6.065582</td>
<td>11.48883</td>
<td>0.0000</td>
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<tr>
<td>RTRADE</td>
<td>0.320017</td>
<td>0.059345</td>
<td>5.392513</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.160919</td>
<td>0.087322</td>
<td>-1.842826</td>
<td>0.0764</td>
</tr>
<tr>
<td>PC2</td>
<td>0.231160</td>
<td>0.113571</td>
<td>2.035384</td>
<td>0.0517</td>
</tr>
<tr>
<td>PC5</td>
<td>0.456653</td>
<td>0.112010</td>
<td>4.076893</td>
<td>0.0004</td>
</tr>
<tr>
<td>PC2(-1)</td>
<td>-1.927551</td>
<td>0.496699</td>
<td>-3.880719</td>
<td>0.0006</td>
</tr>
<tr>
<td>DUMMYPC2(-1)</td>
<td>1.390254</td>
<td>0.501378</td>
<td>2.772868</td>
<td>0.0099</td>
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<tr>
<td>MA(5)</td>
<td>-0.967795</td>
<td>0.017689</td>
<td>-54.71118</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.953139
Mean dependent var: 102.8122
Adjusted R-squared: 0.940989
S.D. dependent var: 2.940504
S.E. of regression: 0.714310
Akaike info criterion: 2.362633
Schwarz criterion: 2.718141
Log likelihood: -33.34608
F-statistic: 78.45247
Prob(F-statistic): 0.000000

Inverted MA Roots: .99 .31+.94i .31-.94i -.80-.58i -.80+.58i
10.2. Regression of real household consumption on real retail trade

\[ HOUS = C(1) + C(2)RTRADE + C(3)RTRADE(-3) + C(4)RTRADE(-4) + C(5)DUMMYRTRADE(-4) \quad [AR(1)=C(6),MA(5)=C(7),BACKCAST=1997Q2] \]

10.3. Regression of real household consumption on real M2

\[ HOUS = C(1) + C(2)M2 + C(3)M2(-4) + C(4)DUMMYM2(-4) \quad [AR(1)=C(5),AR(2)=C(6),MA(5)=C(7),BACKCAST=1997Q3] \]

10.4. Regression of real household consumption on real average industrial wage

\[ HOUS = C(1) + C(2)WAGE + C(3)WAGE(-4) + C(4)DUMMYWAGE(-4) \quad [AR(1)=C(5),MA(5)=C(6),BACKCAST=1997Q2] \]

10.5. Regression of real household consumption on the real koruna/euro exchange rate

\[ HOUS = C(1) + C(2)EURATE + C(3)EURATE(-1) \quad [AR(1)=C(4),MA(5)=C(5),BACKCAST=1996Q3] \]

10.6. Regression of real household consumption on the real koruna/U.S. dollar exchange rate

\[ HOUS = C(1) + C(2)DOLLARRATE(-3) \quad [AR(1)=C(3),MA(5)=C(4),BACKCAST=1997Q1] \]

10.7. ARMA PC1 regression

\[ PC1 = C(1) + C(2)PC1(-1) + C(3)PC1(-2) \quad [MA(5)=C(4),BACKCAST=1996Q3] \]

10.8. ARMA PC2 regression

\[ PC2 = C(1) + C(2)PC2(-1) + C(3)PC2(-3) + C(4)DUMMYPC2(-3) \quad [MA(4)=C(5),BACKCAST=1996Q4] \]

10.9. ARMA PC5 regression

\[ PC5 = C(1) + C(2)PC5(-1) \quad [AR(4)=C(3),MA(4)=C(4),BACKCAST=1997Q2] \]
Table 10.1. Household Consumption Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real household consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1.99%</td>
<td>1.87%</td>
</tr>
<tr>
<td>Real retail trade</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1.80%</td>
<td>4.26%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real retail trade and PCs</td>
<td>10.1</td>
<td>Yes</td>
<td>1.82%</td>
<td>2.67%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>10.2</td>
<td>Yes</td>
<td>2.37%</td>
<td>2.83%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real M2</td>
<td>10.3</td>
<td>Yes</td>
<td>2.94%</td>
<td>2.93%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real average industrial wage</td>
<td>10.4</td>
<td>Yes</td>
<td>3.51%</td>
<td>2.77%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>10.5</td>
<td>No</td>
<td>1.64%</td>
<td>3.40%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real koruna/U.S. dollar exchange rate</td>
<td>10.6</td>
<td>No</td>
<td>2.89%</td>
<td>4.54%</td>
</tr>
</tbody>
</table>
Table 10.2. Household Consumption Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real household consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1.87%</td>
</tr>
<tr>
<td>Real household consumption</td>
<td>Forecast</td>
<td>Real retail trade and PCs</td>
<td>10.1</td>
<td>Yes</td>
<td>2.58%</td>
</tr>
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</table>
11. Government Consumption

Variables

The dependent variable: real government consumption (GOV), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC's):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Government Consumption Regressions

11.1. Regression on real government consumption on principal components

\[ GOV = C(1) + C(2)*GOV(-2) + C(3)*PC2 + C(4)*PC5 + C(5)*PC6 + C(6)*PC7(-2) + \\
   C(7)*PC1(-3) + C(8)*DUMMYPC1(-3) + C(9)*PC4(-4) + \\
   [MA(4)=C(10), BACKCAST=1997Q1] \]

Dependent Variable: GOV  
Method: Least Squares  
Sample (adjusted): 1997Q1 2004Q4  
Included observations: 32 after adjustments  
Convergence achieved after 11 iterations  
Backcast: 1996Q1 1996Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>53.50118</td>
<td>12.35998</td>
<td>4.328581</td>
<td>0.0003</td>
</tr>
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<td>GOV(-2)</td>
<td>0.473952</td>
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<tr>
<td>PC2</td>
<td>-1.508943</td>
<td>0.380047</td>
<td>-3.970417</td>
<td>0.0006</td>
</tr>
<tr>
<td>PC5</td>
<td>-1.671465</td>
<td>0.531818</td>
<td>-3.142924</td>
<td>0.0047</td>
</tr>
<tr>
<td>PC6</td>
<td>1.294755</td>
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<td>1.858201</td>
<td>0.0766</td>
</tr>
<tr>
<td>PC7(-2)</td>
<td>0.671923</td>
<td>0.618812</td>
<td>1.085826</td>
<td>0.2893</td>
</tr>
<tr>
<td>PC1(-3)</td>
<td>1.708207</td>
<td>0.813846</td>
<td>2.098932</td>
<td>0.0475</td>
</tr>
<tr>
<td>DUMMYPC1(-3)</td>
<td>-2.267369</td>
<td>0.790947</td>
<td>-2.866650</td>
<td>0.0090</td>
</tr>
<tr>
<td>PC4(-4)</td>
<td>1.029903</td>
<td>0.422933</td>
<td>2.435145</td>
<td>0.0234</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.903063</td>
<td>0.052450</td>
<td>-17.21745</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.881403  Mean dependent var 101.9559
Adjusted R-squared 0.832886  S.D. dependent var 3.764871
S.E. of regression 1.539066  Akaike info criterion 3.950535
Sum squared resid 52.11190  Schwarz criterion 4.408577
Log likelihood -53.20855  F-statistic 18.16685
Durbin-Watson stat 2.254813  Prob(F-statistic) 0.000000

Inverted MA Roots .97 -.00+.97i -.00-.97i -.97
11.2. Regression on real government consumption on principal components (no dummy variable is included)

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot PC2 + C(4) \cdot PC5 + C(5) \cdot PC6 + C(6) \cdot PC7(-2) + C(7) \cdot PC1(-3) + C(8) \cdot PC4(-4) + [MA(4)=C(9),BACKCAST=1997Q1] \]

11.3. Regression on real government consumption on real M2

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot M2 + C(4) \cdot M2(-1) + [AR(1)=C(5),MA(4)=C(6),BACKCAST=1996Q4] \]

11.4. Regression on real government consumption on the ratio of government budget expenditures to revenues

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot EXPREV(-3) + [AR(1)=C(4),MA(4)=C(5),BACKCAST=1997Q1] \]

11.5. Regression on real government consumption on real retail trade

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot RTRADE(-2) + C(4) \cdot RTRADE(-3) + [AR(1)=C(5),MA(4)=C(6),BACKCAST=1997Q1] \]

11.6. Regression on real government consumption on real transportation sales

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot DUMMYTRANSPORT + C(4) \cdot TRANSPORT(-2) + C(5) \cdot TRANSPORT(-3) + [AR(1)=C(6),MA(4)=C(7),BACKCAST=1997Q1] \]

11.7. Regression on real government consumption on real manufacturing production

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot MNFC + C(4) \cdot MNFC(-4) + [MA(4)=C(5),BACKCAST=1997Q1] \]

11.8. Regression on real government consumption on the ratio of merchandise exports to imports

\[ GOV = C(1) + C(2) \cdot GOV(-2) + C(3) \cdot EXPIMP + C(4) \cdot EXPIMP(-2) + [AR(1)=C(5),MA(4)=C(6),BACKCAST=1996Q4] \]

11.9. ARMA PC2 regression

\[ PC2 = C(1) + C(2) \cdot PC2(-1) + C(3) \cdot PC2(-4) + [MA(7)=C(4),BACKCAST=1997Q1] \]
11.10. ARMA PC5 regression

\[ PC5 = C(1) + C(2) \times PC5(-1) + [AR(4)=C(3),MA(4)=C(4),BACKCAST=1997Q2] \]

11.11. ARMA PC6 regression

\[ PC6 = C(1) + C(2) \times PC6(-1) + [MA(7)=C(3),BACKCAST=1996Q2] \]
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real government consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-3.85%</td>
<td>-5.80%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PCs</td>
<td>11.1</td>
<td>Yes</td>
<td>-4.10%</td>
<td>-5.41%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>PCs</td>
<td>11.2</td>
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<td>-4.68%</td>
<td>-5.67%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real M2</td>
<td>11.3</td>
<td>No</td>
<td>-2.86%</td>
<td>-2.02%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Ratio of government budget expenditures to revenues</td>
<td>11.4</td>
<td>No</td>
<td>-3.58%</td>
<td>-0.78%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>11.5</td>
<td>No</td>
<td>-1.78%</td>
<td>0.92%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>11.6</td>
<td>Yes</td>
<td>-1.33%</td>
<td>2.38%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Real manufacturing production</td>
<td>11.7</td>
<td>No</td>
<td>-1.23%</td>
<td>-1.12%</td>
</tr>
<tr>
<td>Real government consumption</td>
<td>Forecast</td>
<td>Ratio of merchandise exports to imports</td>
<td>11.8</td>
<td>No</td>
<td>-4.02%</td>
<td>-4.54%</td>
</tr>
</tbody>
</table>
### Table 11.2. Government Consumption Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real government consumption</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>-5.80%</td>
</tr>
<tr>
<td>Forecast PCs</td>
<td>11.1</td>
<td>Yes</td>
<td></td>
<td></td>
<td>-4.46%</td>
</tr>
</tbody>
</table>
12. Consumption by Non-Commercial Organizations Serving Households

Variables

The dependent variable: real consumption by non-commercial organizations serving households (NCO), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Non-Commercial Organization Consumption Regressions

12.1. Regression of real consumption by non-commercial organizations on principal components

\[ NCO = C(1) + C(2) \cdot PC1 + C(3) \cdot PC4 + C(4) \cdot PC9 + C(5) \cdot PC10 + C(6) \cdot PC1(-1) + C(7) \cdot PC1(-2) + [AR(1)=C(8),MA(8)=C(9),BACKCAST=1996Q4]\]

Dependent Variable: NCO
Method: Least Squares

Sample (adjusted): 1996Q4 2004Q4
Included observations: 33 after adjustments
Convergence achieved after 19 iterations
Backcast: 1994Q4 1996Q3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>116.6135</td>
<td>16.45004</td>
<td>7.088951</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>-4.286021</td>
<td>1.084297</td>
<td>-3.952811</td>
<td>0.0006</td>
</tr>
<tr>
<td>PC4</td>
<td>2.681675</td>
<td>1.033431</td>
<td>2.594925</td>
<td>0.0159</td>
</tr>
<tr>
<td>PC9</td>
<td>-4.387352</td>
<td>1.278872</td>
<td>-3.430642</td>
<td>0.0022</td>
</tr>
<tr>
<td>PC10</td>
<td>2.469245</td>
<td>1.723858</td>
<td>1.432394</td>
<td>0.1649</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>2.603066</td>
<td>1.110852</td>
<td>2.343307</td>
<td>0.0277</td>
</tr>
<tr>
<td>PC1(-2)</td>
<td>-2.006273</td>
<td>0.929783</td>
<td>-2.157786</td>
<td>0.0412</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.888539</td>
<td>0.082592</td>
<td>10.75819</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(8)</td>
<td>0.969534</td>
<td>0.027760</td>
<td>34.92519</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared    0.854413  Mean dependent var 101.0063
Adjusted R-squared 0.805884 S.D. dependent var 8.636101
S.E. of regression 3.804946 Akaike info criterion 5.737482
Sum squared resid 347.4628 Schwarz criterion 6.145620
Log likelihood -85.66845 F-statistic 17.60622
Durbin-Watson stat 2.120914 Prob(F-statistic) 0.000000

Inverted AR Roots .89
Inverted MA Roots .92+.38i .92-.38i .38-.92i .38+.92i

- .38+.92i -.38-.92i -.92-.38i -.92+.38i
12.2. Regression of real consumption by non-commercial organizations on principal components (a crisis dummy variable is included)

\[ NCO = C(1) + C(2) \cdot PC1 + C(3) \cdot PC4 + C(4) \cdot PC9 + C(5) \cdot PC10 + C(6) \cdot PC1(-1) + C(7) \cdot DUMMYPC1(-1) + C(8) \cdot PC1(-2) + [AR(1)=C(9),MA(8)=C(10),BACKCAST=1996Q4] \]

12.3. Regression of real consumption by non-commercial organizations on real retail trade

\[ NCO = C(1) + C(2) \cdot RTRADE(-4) + [AR(1)=C(3),MA(8)=C(4),BACKCAST=1997Q2] \]

12.4. Regression of real consumption by non-commercial organizations on real average industrial wage

\[ NCO = C(1) + C(2) \cdot WAGE(-2) + [AR(1)=C(3),MA(8)=C(4),BACKCAST=1996Q4] \]

12.5. Regression of real consumption by non-commercial organizations on the ratio of government budget expenditures to revenues

\[ NCO = C(1) + C(2) \cdot EXPREV + [AR(1)=C(3),MA(8)=C(4),BACKCAST=1996Q2] \]

12.6. Regression of real consumption by non-commercial organizations on real M2

\[ NCO = C(1) + C(2) \cdot M2 + C(3) \cdot M2(-2) + C(4) \cdot M2(-3) + [AR(1)=C(5),MA(8)=C(6),BACKCAST=1997Q1] \]

12.7. Regression of real consumption by non-commercial organizations on the unemployment rate

\[ NCO = C(1) + C(2) \cdot UNEMPL + [AR(1)=C(3),MA(8)=C(4),BACKCAST=1996Q2] \]

12.8. Regression of real consumption by non-commercial organizations on the real koruna/euro exchange rate

\[ NCO = C(1) + C(2) \cdot EURATE + C(3) \cdot EURATE(-1) + [AR(1)=C(4),MA(8)=C(5),BACKCAST=1996Q3] \]

12.9. ARMA PC1 regression

\[ PC1 = C(1) + C(2) \cdot PC1(-1) + C(3) \cdot PC1(-4) + [MA(4)=C(4),BACKCAST=1997Q1] \]

12.10. ARMA PC4 regression

\[ PC4 = C(1) + C(2) \cdot PC4(-1) + C(3) \cdot PC4(-2) + [MA(3)=C(4),MA(6)=C(5),BACKCAST=1996Q3] \]
12.11. ARMA PC9 regression

\[ PC9 = C(1) + C(2)*PC9(-1) + C(3)*PC9(-4) \]

12.12. ARMA PC10 regression

\[ PC10 = C(1) + C(2)*PC10(-1) + C(3)*PC10(-4) + \]
\[ [AR(1)=C(4),MA(5)=C(5),BACKCAST=1997Q2] \]
Table 12.1. Growth Rates of Consumption by Non-Commercial Organizations. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>11.74%</td>
<td>7.07%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>PCs</td>
<td>12.1</td>
<td>No</td>
<td>10.83%</td>
<td>7.59%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>PCs</td>
<td>12.2</td>
<td>Yes</td>
<td>10.41%</td>
<td>7.45%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>Real retail trade</td>
<td>12.3</td>
<td>No</td>
<td>9.58%</td>
<td>7.13%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>Real average industrial wage</td>
<td>12.4</td>
<td>No</td>
<td>9.56%</td>
<td>7.11%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>Ratio of government budget expenditures to revenues</td>
<td>12.5</td>
<td>No</td>
<td>10.78%</td>
<td>8.83%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>Real M2</td>
<td>12.6</td>
<td>No</td>
<td>10.78%</td>
<td>8.83%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>Unemployment rate</td>
<td>12.7</td>
<td>No</td>
<td>4.87%</td>
<td>2.96%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>12.8</td>
<td>No</td>
<td>17.58%</td>
<td>9.26%</td>
</tr>
</tbody>
</table>
Table 12.2. Growth Rates of Consumption by Non-Commercial Organizations. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.07%</td>
</tr>
<tr>
<td>Real consumption by non-commercial organizations</td>
<td>Forecast</td>
<td>PCs</td>
<td>12.1</td>
<td>No</td>
<td>7.52%</td>
</tr>
</tbody>
</table>
13. Investment

Variables

The dependent variable: real gross investment (TOTINV), year-over-year index

The special variable: real construction (CONSTR), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Ratio of exports to imports (in U.S. dollars)
- Real M2
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to industrial producer prices
- Ratio of industrial producer prices to construction prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Gross Investment Regressions

13.1. Regression of real investment on real construction and principal components

\[ TOTINV = C(1) + C(2) \times TOTINV(-4) + C(3) \times CONSTR(-1) + C(4) \times PC1 + C(5) \times PC8 + C(6) \times PC5(-1) + [AR(1)=C(7), MA(6)=C(8), BACKCAST=1997Q2] \]

Dependent Variable: TOTINV
Method: Least Squares

Sample (adjusted): 1997Q2 2004Q4
Included observations: 31 after adjustments
Convergence achieved after 26 iterations
Backcast: 1995Q4 1997Q1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>111.1532</td>
<td>9.560342</td>
<td>11.62649</td>
<td>0.0000</td>
</tr>
<tr>
<td>TOTINV(-4)</td>
<td>-0.397646</td>
<td>0.072303</td>
<td>-5.499733</td>
<td>0.0000</td>
</tr>
<tr>
<td>CONSTR(-1)</td>
<td>0.321149</td>
<td>0.087439</td>
<td>3.672833</td>
<td>0.0013</td>
</tr>
<tr>
<td>PC1</td>
<td>-1.272161</td>
<td>0.279599</td>
<td>-4.549954</td>
<td>0.0001</td>
</tr>
<tr>
<td>PC8</td>
<td>1.916161</td>
<td>0.753968</td>
<td>2.541434</td>
<td>0.0182</td>
</tr>
<tr>
<td>PC5(-1)</td>
<td>-1.191852</td>
<td>0.561542</td>
<td>-2.122463</td>
<td>0.0448</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.412417</td>
<td>0.190812</td>
<td>-2.161382</td>
<td>0.0413</td>
</tr>
<tr>
<td>MA(6)</td>
<td>0.949297</td>
<td>0.025694</td>
<td>36.94588</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.913468
Adjusted R-squared 0.887132
S.D. dependent var 7.796284
Mean dependent var 102.2005
S.E. of regression 2.619231
Akaike information criterion 4.981275
Schwarz criterion 5.351336
Log likelihood -69.20976
F-statistic 34.68518
Prob(F-statistic) 0.000000

Inverted AR Roots -.41
Inverted MA Roots .86+.50i .86-.50i .00-.99i -.00+.99i

- .86+.50i -.86-.50i
13.2. Regression of real investment on real construction

$$TOTINV = C(1) + C(2) \cdot TOTINV(-4) + C(3) \cdot CONSTR + C(4) \cdot CONSTR(-2) + C(5) \cdot CONSTR(-4) + [AR(1)=C(6), MA(4)=C(7), BACKCAST=1997Q2]$$

13.3. Regression of real investment on real M2

$$TOTINV = C(1) + C(2) \cdot M2(-1) + C(3) \cdot M2(-3) + C(4) \cdot DUMMYM2(-3) + [AR(1)=C(5), MA(6)=C(6), BACKCAST=1997:1]$$

13.4. Regression of real investment on real industrial production

$$TOTINV = C(1) + C(2) \cdot TOTINV(-4) + C(3) \cdot IND + [AR(1)=C(4), MA(5)=C(5), BACKCAST=1997:2]$$

13.5. Regression of real investment on the real interest rate

$$TOTINV = C(1) + C(2) \cdot TOTINV(-4) + C(3) \cdot RIR + C(4) \cdot RIR(-1) + C(5) \cdot RIR(-2) + [MA(4)=C(6), BACKCAST=1997:1]$$

13.6. Regression of real investment on real transportation

$$TOTINV = C(1) + C(2) \cdot TRANSPORT(-2) + C(3) \cdot TRANSPORT(-3) + C(4) \cdot DUMMYTRANSPORT(-3) + [MA(4)=C(5), BACKCAST=1996:4]$$

13.7. ARMA PC1 regression

$$CONSTR = C(1) + C(2) \cdot CONSTR(-1) + [MA(4)=C(3), MA(7)=C(4), BACKCAST=1996:2]$$

13.8. ARMA PC8 regression

$$PC8 = C(1) + C(2) \cdot PC8(-1) + C(3) \cdot PC8(-4) + [MA(8)=C(4), BACKCAST=1997:1]$$
Table 13.1. Investment Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>8.93%</td>
<td>4.97%</td>
</tr>
<tr>
<td>Real construction</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.40%</td>
<td>4.67%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real construction</td>
<td>13.1</td>
<td>No</td>
<td>8.58%</td>
<td>4.63%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real construction</td>
<td>13.2</td>
<td>No</td>
<td>14.91%</td>
<td>10.39%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real M2</td>
<td>13.3</td>
<td>Yes</td>
<td>9.43%</td>
<td>4.56%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real industrial production</td>
<td>13.4</td>
<td>No</td>
<td>10.64%</td>
<td>13.29%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real interest rate</td>
<td>13.5</td>
<td>No</td>
<td>12.20%</td>
<td>11.13%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>13.6</td>
<td>Yes</td>
<td>8.24%</td>
<td>9.43%</td>
</tr>
</tbody>
</table>
Table 13.2. Investment Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real investment</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.97%</td>
</tr>
<tr>
<td>Real investment</td>
<td>Forecast</td>
<td>PCs</td>
<td>13.1</td>
<td>No</td>
<td>4.52%</td>
</tr>
</tbody>
</table>
14. Exports

Variables

The **dependent variable**: real exports of goods and services (EXPGS), year-over-year index

The **special variable**: merchandise exports (in euro) (EUROEXP), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Real M2
- Merchandise imports (in euro)
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to transportation prices
- Ratio of industrial producer prices to transportation prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Exports Regressions

14.1. Regression of real exports of goods and services on merchandise exports (in euro) and principal components

\[ \text{EXPGS} = C(1) + C(2) \times \text{EUROEXP} + C(3) \times \text{DUMMYPC5}(-2) + C(4) \times \text{PC2}(-4) + \]
\[ [\text{AR}(1)=C(5), \text{AR}(2)=C(6), \text{MA}(4)=C(7), \text{BACKCAST}=1997:3] \]

Dependent Variable: EXPGS  
Method: Least Squares  
Sample(adjusted): 1997:3 2004:4  
Included observations: 30 after adjusting endpoints  
Convergence achieved after 42 iterations  
Backcast: 1996:3 1997:2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>23.71442</td>
<td>6.416494</td>
<td>3.695853</td>
<td>0.0012</td>
</tr>
<tr>
<td>EUROEXP</td>
<td>0.748921</td>
<td>0.055405</td>
<td>13.51716</td>
<td>0.0000</td>
</tr>
<tr>
<td>DUMMYPC5(-2)</td>
<td>1.268105</td>
<td>0.493224</td>
<td>2.571054</td>
<td>0.0171</td>
</tr>
<tr>
<td>PC2(-4)</td>
<td>1.243461</td>
<td>0.350519</td>
<td>3.547485</td>
<td>0.0017</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.874997</td>
<td>0.192793</td>
<td>4.538529</td>
<td>0.0001</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.244214</td>
<td>0.197897</td>
<td>-1.234047</td>
<td>0.2296</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.919745</td>
<td>0.036968</td>
<td>-24.87943</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared: 0.969239  
Mean dependent var: 110.8455  
Adjusted R-squared: 0.961215  
S.D. dependent var: 7.861741  
S.E. of regression: 1.548290  
Akaike info criterion: 3.913142  
Sum squared resid: 55.13561  
Schwarz criterion: 4.240088  
Log likelihood: -51.69713  
F-statistic: 120.7844  
Durbin-Watson stat: 1.934188  
Prob(F-statistic): 0.000000  
Inverted AR Roots: .44 -.23i  
.44+.23i  
Inverted MA Roots: .98 -.00+.98i  
-.00 -.98i  
-.98
14.2. Regression of real exports of goods and services on merchandise exports (in euro) and principal components (no crisis dummy variables)

\[
EXPGS = C(1) + C(2)\text{EUROEXP} + C(3)\text{PC5(-2)} + C(4)\text{PC2(-4)} + \\
[AR(1)=C(5),AR(2)=C(6),MA(4)=C(7),BACKCAST=1997Q3]
\]

14.3. Regression of real exports of goods and services on merchandise exports (in euro)

\[
EXPGS = C(1) + C(2)\text{EUROEXP} + \\
[AR(1)=C(3),AR(2)=C(4),MA(4)=C(5),BACKCAST=1996Q3]
\]

14.4. Regression of real exports of goods and services on real transportation sales

\[
EXPGS = C(1) + C(2)\text{TRANSPORT} + \\
[AR(1)=C(3),AR(2)=C(4),MA(4)=C(5),BACKCAST=1996Q3]
\]

14.5. Regression of real exports of goods and services on real manufacturing production

\[
EXPGS = C(1) + C(2)\text{MNFC} + C(3)\text{MNFC(-4)} + \\
[AR(1)=C(4),MA(4)=C(5),BACKCAST=1997Q2]
\]

14.6. Regression of real exports of goods and services on the real koruna/euro exchange rate

\[
EXPGS = C(1) + C(2)\text{EURATE(-1)} + \\
[AR(1)=C(3),MA(4)=C(4),BACKCAST=1996Q3]
\]

14.7. Regression of real exports of goods and services on the real German GDP

\[
EXPGS = C(1) + C(2)\text{GERGDP} + [AR(1)=C(3),MA(4)=C(4),BACKCAST=1996Q2]
\]

14.8. ARMA merchandise exports regression

\[
\text{EUROEXP} = C(1) + C(2)\text{EUROEXP(-1)} + \\
\]
Table 14.1. Exports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>22.97%</td>
<td>22.15%</td>
</tr>
<tr>
<td>Merchandise exports (in euro)</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>30.72%</td>
<td>29.49%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise exports (in euro) and PCs</td>
<td>14.1</td>
<td>Yes</td>
<td>24.08%</td>
<td>22.01%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise exports (in euro) and PCs</td>
<td>14.2</td>
<td>No</td>
<td>24.20%</td>
<td>22.77%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise exports (in euro)</td>
<td>14.3</td>
<td>No</td>
<td>26.05%</td>
<td>23.73%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>14.4</td>
<td>No</td>
<td>24.17%</td>
<td>17.29%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real manufacturing production</td>
<td>14.5</td>
<td>No</td>
<td>19.69%</td>
<td>16.71%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>14.6</td>
<td>No</td>
<td>22.18%</td>
<td>17.57%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real German GDP</td>
<td>14.7</td>
<td>No</td>
<td>20.72%</td>
<td>14.70%</td>
</tr>
</tbody>
</table>
Table 14.2. Exports of Goods and Services Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>22.15%</td>
</tr>
<tr>
<td>Real exports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise exports (in euro) and PCs</td>
<td>14.1</td>
<td>Yes</td>
<td>21.63%</td>
</tr>
</tbody>
</table>
15. Imports

Variables

The dependent variable: real imports of goods and services (IMPGS), year-over-year index

The special variable: merchandise imports (in euro) (EUROIMP), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Real mining production
- Real manufacturing production
- Real utilities production
- Real construction
- Real transportation sales
- Real retail trade
- Ratio of government budget expenditures to revenues
- Real M2
- Merchandise exports (in euro)
- Real koruna/U.S. dollar exchange rate
- Real koruna/euro exchange rate
- Unemployment rate
- Real average industrial wage
- Ratio of consumer prices to transportation prices
- Ratio of industrial producer prices to transportation prices
- Real interest rate
- Industrial confidence index
- Construction confidence index
- Trade confidence index
Real Imports Regressions

15.1. Regression of real imports of goods and services on merchandise imports (in euro) and principal components

\[ \text{IMPGS} = C(1) + C(2) \times \text{EUROIMP} + C(3) \times \text{PC4} + C(4) \times \text{PC1}(-1) + C(5) \times \text{PC1}(-2) + C(6) \times \text{PC5}(-2) + [\text{AR}(1)=C(7), \text{AR}(2)=C(8), \text{MA}(1)=C(9), \text{MA}(2)=C(10), \text{BACKCAST}=1997Q1] \]

Dependent Variable: IMPGS
Method: Least Squares

Sample (adjusted): 1997Q1 2004Q4
Included observations: 32 after adjustments
Convergence achieved after 34 iterations
Backcast: 1996Q3 1996Q4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>39.27275</td>
<td>5.798592</td>
<td>6.772809</td>
<td>0.0000</td>
</tr>
<tr>
<td>EUROIMP</td>
<td>0.632431</td>
<td>0.051167</td>
<td>12.36021</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC4</td>
<td>-1.919024</td>
<td>0.424005</td>
<td>-4.525951</td>
<td>0.0002</td>
</tr>
<tr>
<td>PC1(-1)</td>
<td>1.473582</td>
<td>0.491181</td>
<td>3.000081</td>
<td>0.0066</td>
</tr>
<tr>
<td>PC1(-2)</td>
<td>-1.485620</td>
<td>0.464901</td>
<td>-3.195559</td>
<td>0.0042</td>
</tr>
<tr>
<td>PC5(-2)</td>
<td>-0.779121</td>
<td>0.487383</td>
<td>-1.598581</td>
<td>0.1242</td>
</tr>
<tr>
<td>AR(1)</td>
<td>1.255085</td>
<td>0.135534</td>
<td>9.260325</td>
<td>0.0000</td>
</tr>
<tr>
<td>AR(2)</td>
<td>-0.546500</td>
<td>0.133964</td>
<td>-4.079454</td>
<td>0.0005</td>
</tr>
<tr>
<td>MA(1)</td>
<td>-0.997425</td>
<td>0.206192</td>
<td>-4.837359</td>
<td>0.0001</td>
</tr>
<tr>
<td>MA(2)</td>
<td>0.472494</td>
<td>0.197910</td>
<td>2.387421</td>
<td>0.0260</td>
</tr>
</tbody>
</table>

R-squared 0.938713  Mean dependent var 110.1705
Adjusted R-squared 0.913641  S.D. dependent var 6.149335
S.E. of regression 1.807100  Akaike info criterion 4.271630
Sum squared resid 71.84341  Schwarz criterion 4.729673
Log likelihood -58.34608  F-statistic 37.44071
Durbin-Watson stat 1.906932  Prob(F-statistic) 0.000000

Inverted AR Roots .63-.39i .63+.39i
Inverted MA Roots .50-.47i .50+.47i
15.2. Regression of real imports of goods and services on merchandise imports (in euro) and principal components (a crisis dummy variable is included)

\[ \text{IMPGS} = C(1) + C(2) \times \text{EUROIMP} + C(3) \times \text{PC4} + C(4) \times \text{PC1(-1)} + C(5) \times \text{PC1(-2)} + \\
C(6) \times \text{DUMMYPC1(-2)} + C(7) \times \text{PC5(-2)} + \\
[AR(1)=C(8),AR(2)=C(9),MA(1)=C(10),MA(2)=C(11),BACKCAST=1997Q1] \]

15.3. Regression of real imports of goods and services on merchandise imports (in euro)

\[ \text{IMPGS} = C(1) + C(2) \times \text{EUROIMP} + C(3) \times \text{EUROIMP(-1)} + C(4) \times \text{EUROIMP(-4)} + \\
[AR(1)=C(5),MA(1)=C(6),MA(5)=C(7),BACKCAST=1997Q2] \]

15.4. Regression of real imports of goods and services on real transportation sales

\[ \text{IMPGS} = C(1) + C(2) \times \text{TRANSPORT} + C(3) \times \text{TRANSPORT(-2)} + \\
[MA(1)=C(4),MA(2)=C(5),BACKCAST=1996Q3] \]

15.5. Regression of real imports of goods and services on real manufacturing production

\[ \text{IMPGS} = C(1) + C(2) \times \text{MNFC} + C(3) \times \text{DUMMYMNFC} + C(4) \times \text{MNFC(-2)} + \\
C(5) \times \text{MNFC(-3)} + C(6) \times \text{MNFC(-4)} + [AR(1)=C(7),MA(5)=C(8),BACKCAST=1997Q2] \]

15.6. Regression of real imports of goods and services on the real koruna/euro exchange rate

\[ \text{IMPGS} = C(1) + C(2) \times \text{EURATE} + C(3) \times \text{EURATE(-3)} + \\
[AR(1)=C(4),MA(2)=C(5),MA(5)=C(6),BACKCAST=1997Q1] \]

15.7. Regression of real imports of goods and services on the real koruna/euro exchange rate

\[ \text{IMPGS} = C(1) + C(2) \times \text{DOLLARRATE(-3)} + C(3) \times \text{DOLLARRATE(-4)} + \\
[MA(1)=C(4),MA(5)=C(5),BACKCAST=1997Q1] \]

15.8. ARMA merchandise imports regression

\[ \text{DUMMY4} = 1 \text{ in 1999Q1, } = 0 \text{ otherwise} \]

\[ \text{EUROIMP} = C(1) + C(2) \times \text{DUMMY4} + C(3) \times \text{EUROIMP(-1)} + \\
[AR(1)=C(4),MA(1)=C(5),BACKCAST=1996Q3] \]

15.9. ARMA PC4 regression

\[ \text{PC4} = C(1) + C(2) \times \text{PC4(-1)} + C(3) \times \text{PC4(-2)} + [MA(7)=C(4),BACKCAST=1996Q3] \]
Table 15.1. Imports of Goods and Services Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real imports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>19.86%</td>
<td>15.84%</td>
</tr>
<tr>
<td>Merchandise imports (in euro)</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>25.76%</td>
<td>20.47%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise imports (in euro) and PCs</td>
<td>15.1</td>
<td>No</td>
<td>19.78%</td>
<td>16.83%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise imports (in euro) and PCs</td>
<td>15.2</td>
<td>Yes</td>
<td>20.22%</td>
<td>18.28%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise imports (in euro)</td>
<td>15.3</td>
<td>No</td>
<td>24.32%</td>
<td>18.97%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real transportation sales</td>
<td>15.4</td>
<td>No</td>
<td>17.86%</td>
<td>14.22%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real manufacturing production</td>
<td>15.5</td>
<td>Yes</td>
<td>18.33%</td>
<td>18.57%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real koruna/euro exchange rate</td>
<td>15.6</td>
<td>No</td>
<td>24.96%</td>
<td>21.56%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real koruna/U.S. dollar exchange rate</td>
<td>15.7</td>
<td>No</td>
<td>19.89%</td>
<td>9.22%</td>
</tr>
</tbody>
</table>
Table 15.2. Imports of Goods and Services Growth Rates. Official Figure and Out-of-Sample Forecast Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real imports of goods and services</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>15.84%</td>
</tr>
<tr>
<td>Real imports of goods and services</td>
<td>Forecast</td>
<td>Real merchandise exports (in euro) and PCs</td>
<td>15.1</td>
<td>No</td>
<td>16.25%</td>
</tr>
</tbody>
</table>
16. GDP Deflator

Variables

The dependent variable: GDP deflator (DEFLATOR), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Nominal M2
- Nominal average industrial wage
- Transportation and communication prices
- Financial intermediation and insurance prices
- Mining producer prices
- Manufacturing producer prices
- Utilities producer prices
- Agricultural producer prices
- Construction prices
- Consumer prices
- Nominal koruna/U.S. dollar exchange rate
- Nominal koruna/euro exchange rate
- Business confidence index
GDP Deflator Regressions

16.1. Regression of GDP deflator on principal components

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DEFLATOR}(-1) + C(3) \times PC1 + C(4) \times PC2 + \]
\[ \{AR(1)=C(5), MA(4)=C(6), BACKCAST=1996Q3\} \]

Dependent Variable: DEFLATOR
Method: Least Squares

Sample (adjusted): 1996Q3 2004Q4
Included observations: 34 after adjustments
Convergence achieved after 21 iterations
Backcast: 1995Q3 1996Q2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>57.49979</td>
<td>24.13800</td>
<td>2.382127</td>
<td>0.0242</td>
</tr>
<tr>
<td>DEFLATOR(-1)</td>
<td>0.451152</td>
<td>0.230165</td>
<td>1.960123</td>
<td>0.0600</td>
</tr>
<tr>
<td>PC1</td>
<td>0.715928</td>
<td>0.325376</td>
<td>2.200312</td>
<td>0.0362</td>
</tr>
<tr>
<td>PC2</td>
<td>0.399330</td>
<td>0.289546</td>
<td>1.379159</td>
<td>0.1788</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.599552</td>
<td>0.267110</td>
<td>2.244588</td>
<td>0.0329</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.870797</td>
<td>0.079293</td>
<td>-10.98203</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.937990 Mean dependent var 104.8716
Adjusted R-squared 0.926916 S.D. dependent var 3.554174
S.E. of regression 0.960835 Akaike info criterion 2.916758
Sum squared resid 25.84972 Schwarz criterion 3.186115
Log likelihood -43.58488 F-statistic 84.70743
Durbin-Watson stat 1.848604 Prob(F-statistic) 0.000000

Inverted AR Roots .60
Inverted MA Roots .97 .00-.97i -.00+.97i -.97
16.2. Regression of GDP deflator on consumer prices

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DEFLATOR}(-1) + C(3) \times \text{CPI} + C(4) \times \text{CPI}(-4) + [\text{MA}(4)=C(5), \text{BACKCAST}=1997Q1] \]

16.3. Regression of GDP deflator on manufacturing producer prices

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DEFLATOR}(-1) + C(3) \times \text{MANPR} + [\text{AR}(1)=C(4), \text{MA}(4)=C(5), \text{BACKCAST}=1996Q3] \]

16.4. Regression of GDP deflator on transportation and communication prices

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DEFLATOR}(-1) + C(3) \times \text{TRPR}(-1) + C(4) \times \text{TRPR}(-3) + [\text{MA}(5)=C(5), \text{BACKCAST}=1996Q4] \]

16.5. Regression of GDP deflator on construction prices

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DUMMYDEFLATOR}(-1) + C(3) \times \text{CONSTRPR} + [\text{AR}(1)=C(4), \text{AR}(2)=C(5), \text{MA}(4)=C(6), \text{BACKCAST}=1996Q4] \]

16.6. Regression of GDP deflator on business confidence index

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DEFLATOR}(-1) + C(3) \times \text{BUSINESS}(-2) + C(4) \times \text{BUSINESS}(-4) + C(5) \times \text{DUMMYBUSINESS}(-4) + [\text{MA}(4)=C(6), \text{BACKCAST}=1997Q1] \]

16.7. Regression of GDP deflator on nominal M2

\[ \text{DEFLATOR} = C(1) + C(2) \times \text{DEFLATOR}(-1) + C(3) \times \text{DUMMYNOMM2} + C(4) \times \text{NOMM2}(-3) + [\text{AR}(1)=C(5), \text{AR}(2)=C(6), \text{MA}(4)=C(7), \text{BACKCAST}=1997Q2] \]

16.8. ARMA PC1 regression

\[ \text{PC1} = C(1) + C(2) \times \text{DUMMY1} + C(3) \times \text{PC1}(-1) + [\text{AR}(1)=C(4), \text{MA}(3)=C(5), \text{BACKCAST}=1996Q3] \]

16.9. ARMA PC2 regression

\[ \text{PC2} = C(1) + [\text{AR}(1)=C(2), \text{AR}(2)=C(3), \text{MA}(4)=C(4), \text{BACKCAST}=1996Q3] \]
### Table 16.1. GDP Deflator Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4.03%</td>
<td>3.31%</td>
</tr>
<tr>
<td>Forecast</td>
<td>PCs</td>
<td>16.1</td>
<td>No</td>
<td>4.13%</td>
<td>3.32%</td>
</tr>
<tr>
<td>Forecast</td>
<td>Consumer prices</td>
<td>16.2</td>
<td>No</td>
<td>4.42%</td>
<td>3.52%</td>
</tr>
<tr>
<td>Forecast</td>
<td>Manufacturing producer prices</td>
<td>16.3</td>
<td>No</td>
<td>4.50%</td>
<td>4.17%</td>
</tr>
<tr>
<td>Forecast</td>
<td>Transportation and communication prices</td>
<td>16.4</td>
<td>No</td>
<td>3.52%</td>
<td>2.99%</td>
</tr>
<tr>
<td>Forecast</td>
<td>Construction prices</td>
<td>16.5</td>
<td>Yes</td>
<td>3.81%</td>
<td>2.54%</td>
</tr>
<tr>
<td>Forecast</td>
<td>Business confidence index</td>
<td>16.6</td>
<td>Yes</td>
<td>3.89%</td>
<td>3.82%</td>
</tr>
<tr>
<td>Forecast</td>
<td>Nominal M2</td>
<td>16.7</td>
<td>Yes</td>
<td>2.64%</td>
<td>1.33%</td>
</tr>
</tbody>
</table>
Table 16.2. GDP Deflator Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3.31%</td>
</tr>
<tr>
<td>Forecast</td>
<td>PCs</td>
<td>16.1</td>
<td>No</td>
<td>3.43%</td>
</tr>
</tbody>
</table>
Table 16.3. Partial Derivatives of GDP Deflator with Respect to:

<table>
<thead>
<tr>
<th>Category</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal M2</td>
<td>0.0211</td>
</tr>
<tr>
<td>Nominal average industrial wage</td>
<td>0.3004</td>
</tr>
<tr>
<td>Transportation and communication prices</td>
<td>0.1748</td>
</tr>
<tr>
<td>Financial intermediation and insurance prices</td>
<td>0.1756</td>
</tr>
<tr>
<td>Mining producer prices</td>
<td>0.0476</td>
</tr>
<tr>
<td>Manufacturing producer prices</td>
<td>0.3626</td>
</tr>
<tr>
<td>Utilities producer prices</td>
<td>0.0433</td>
</tr>
<tr>
<td>Agricultural producer prices</td>
<td>0.3374</td>
</tr>
<tr>
<td>Construction prices</td>
<td>0.3077</td>
</tr>
<tr>
<td>Consumer prices</td>
<td>0.3353</td>
</tr>
<tr>
<td>Nominal koruna/U.S. dollar exchange rate</td>
<td>0.2330</td>
</tr>
<tr>
<td>Nominal koruna/euro exchange rate</td>
<td>0.0483</td>
</tr>
<tr>
<td>Business confidence index</td>
<td>0.0824</td>
</tr>
</tbody>
</table>
17. Nominal GDP

Variables

The dependent variable: nominal GDP (NGDP), year-over-year index

The set of monthly indicators used in the extraction of the principal components (PC’s):

- Mining production
- Manufacturing production
- Utilities production
- Construction
- Transportation sales
- Retail trade
- Nominal merchandise exports
- Nominal merchandise imports
- Nominal M2
- Nominal average industrial wage
- Transportation and communication prices
- Industrial producer prices
- Agricultural producer prices
- Construction prices
- Consumer prices
- Nominal koruna/U.S. dollar exchange rate
- Nominal koruna/euro exchange rate
- Business confidence index
Nominal GDP Regressions

17.1. Regression of nominal GDP on principal components

\[ NGDP = C(1) + C(2)*NGDP(-1) + C(3)*PC1 + C(4)*DUMMYPC1 + C(5)*PC2 + [MA(2)=C(6),MA(4)=C(7),BACKCAST=1996:2] \]

Dependent Variable: NGDP
Method: Least Squares

Sample(adjusted): 1996:2 2004:4
Included observations: 35 after adjusting endpoints
Convergence achieved after 45 iterations
Backcast: 1995:2 1996:1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>26.15061</td>
<td>11.75178</td>
<td>2.225247</td>
<td>0.0343</td>
</tr>
<tr>
<td>NGDP(-1)</td>
<td>0.754170</td>
<td>0.110412</td>
<td>6.830491</td>
<td>0.0000</td>
</tr>
<tr>
<td>PC1</td>
<td>0.927710</td>
<td>0.424294</td>
<td>2.186479</td>
<td>0.0373</td>
</tr>
<tr>
<td>DUMMYPC1</td>
<td>-0.642110</td>
<td>0.435619</td>
<td>-1.474020</td>
<td>0.1516</td>
</tr>
<tr>
<td>PC2</td>
<td>-0.205838</td>
<td>0.084308</td>
<td>-2.441484</td>
<td>0.0212</td>
</tr>
<tr>
<td>MA(2)</td>
<td>-0.275280</td>
<td>0.171107</td>
<td>-1.608814</td>
<td>0.1189</td>
</tr>
<tr>
<td>MA(4)</td>
<td>-0.603016</td>
<td>0.171669</td>
<td>-3.512667</td>
<td>0.0015</td>
</tr>
</tbody>
</table>

R-squared 0.893500  Mean dependent var 107.1323
Adjusted R-squared 0.870679  S.D. dependent var 2.873752
S.E. of regression 1.033438  Akaike info criterion 3.080515
Sum squared resid 29.90383  Schwarz criterion 3.391585
Log likelihood -46.90902  F-statistic 39.15183
Durbin-Watson stat 1.902380  Prob(F-statistic) 0.000000

Inverted MA Roots .96 .00-.81i -.00+.81i -.96
17.2. Regression of nominal GDP on principal components (no crisis dummy variables)

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * PC1 + C(4) * PC2 + [MA(2)=C(5),MA(4)=C(6),BACKCAST=1996Q2] \]

17.3. Nominal GDP regression (no independent variables)

\[ NGDP = C(1) + C(2) * NGDP(-1) + [MA(4)=C(3),BACKCAST=1996Q2] \]

17.4. Regression of nominal GDP on the nominal koruna/euro exchange rate

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * NOMEURATE + C(4) * DUMMYNOMEURATE + [MA(4)=C(5),BACKCAST=1996:2] \]

17.5. Regression of nominal GDP on the nominal koruna/U.S. dollar exchange rate

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * NDOLRATE + C(4) * NDOLRATE(-1) + C(5) * NDOLRATE(-3) + [MA(4)=C(6),BACKCAST=1996Q4] \]

17.6. Regression of nominal GDP on consumer prices

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * CPI + C(4) * CPI(-4) + [MA(4)=C(5),BACKCAST=1997:1] \]

17.7. Regression of nominal GDP on the business confidence index

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * DUMMYBUSINESS(-3) + C(4) * BUSINESS(-4) + [MA(4)=C(5),BACKCAST=1997:1] \]

17.8. Regression of nominal GDP on nominal M2

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * NOMM2(-3) + [MA(4)=C(4),BACKCAST=1996Q4] \]

17.9. Regression of nominal GDP on nominal merchandise imports

\[ NGDP = C(1) + C(2) * NGDP(-1) + C(3) * NOMIMP(-1) + C(4) * DUMMYNOMIMP(-1) + [MA(4)=C(5),BACKCAST=1996Q2] \]

17.10. ARMA PC1 regression

\[ PC1 = C(1) + C(2) * PC1(-1) + C(3) * DUMMYPC1(-1) + C(4) * PC1(-2) + [MA(4)=C(5),BACKCAST=1996Q3] \]
17.11. ARMA PC2 regression

\[ PC2 = C(1) + C(2) \times PC2(-1) + [AR(4)=C(3), MA(5)=C(4), BACKCAST=1997Q2] \]
Table 17.1. Nominal GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Official Independent Variables

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Official or forecast</th>
<th>Independent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 III</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>8.22%</td>
<td>7.75%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>17.1</td>
<td>Yes</td>
<td>8.06%</td>
<td>7.83%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>17.2</td>
<td>No</td>
<td>8.21%</td>
<td>8.02%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>ARMA</td>
<td>17.3</td>
<td>No</td>
<td>8.52%</td>
<td>7.60%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal koruna/euro exchange rate</td>
<td>17.4</td>
<td>Yes</td>
<td>8.33%</td>
<td>7.25%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal koruna/U.S. dollar exchange rate</td>
<td>17.5</td>
<td>No</td>
<td>8.46%</td>
<td>7.84%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Consumer prices</td>
<td>17.6</td>
<td>No</td>
<td>8.49%</td>
<td>7.71%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Business confidence index</td>
<td>17.7</td>
<td>Yes</td>
<td>8.60%</td>
<td>7.79%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal M2</td>
<td>17.8</td>
<td>No</td>
<td>8.04%</td>
<td>7.10%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>Nominal merchandise imports</td>
<td>17.9</td>
<td>Yes</td>
<td>9.06%</td>
<td>8.18%</td>
</tr>
</tbody>
</table>
### Table 17.2. Nominal GDP Growth Rates. Official Figures and Out-of-Sample Forecasts Based on Forecasted Contemporaneous Independent Variables

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Official or forecast</th>
<th>Dependent variables</th>
<th>Regression number</th>
<th>Crisis dummies</th>
<th>2004 IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP</td>
<td>Official</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>7.75%</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>Forecast</td>
<td>PCs</td>
<td>17.1</td>
<td>Yes</td>
<td>8.06%</td>
</tr>
</tbody>
</table>
Table 17.3. Pre-Crisis Partial Derivatives of Nominal GDP with Respect to:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining production</td>
<td>0.1964</td>
</tr>
<tr>
<td>Manufacturing production</td>
<td>0.2545</td>
</tr>
<tr>
<td>Utilities production</td>
<td>0.0616</td>
</tr>
<tr>
<td>Construction</td>
<td>0.1218</td>
</tr>
<tr>
<td>Transportation sales</td>
<td>0.2108</td>
</tr>
<tr>
<td>Retail trade</td>
<td>0.0391</td>
</tr>
<tr>
<td>Nominal merchandise exports</td>
<td>0.3355</td>
</tr>
<tr>
<td>Nominal merchandise imports</td>
<td>0.3510</td>
</tr>
<tr>
<td>Nominal M2</td>
<td>0.0289</td>
</tr>
<tr>
<td>Nominal average industrial wage</td>
<td>0.2306</td>
</tr>
<tr>
<td>Transportation and communication prices</td>
<td>0.1830</td>
</tr>
<tr>
<td>Industrial producer prices</td>
<td>0.3348</td>
</tr>
<tr>
<td>Agricultural producer prices</td>
<td>0.2867</td>
</tr>
<tr>
<td>Construction prices</td>
<td>0.2148</td>
</tr>
<tr>
<td>Consumer prices</td>
<td>0.2414</td>
</tr>
<tr>
<td>Nominal koruna/U.S. dollar exchange rate</td>
<td>0.2746</td>
</tr>
<tr>
<td>Nominal koruna/euro exchange rate</td>
<td>0.1652</td>
</tr>
<tr>
<td>Business confidence index</td>
<td>0.1023</td>
</tr>
</tbody>
</table>
Table 17.4. Post-Crisis Partial Derivatives of Nominal GDP with Respect to:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining production</td>
<td>0.1004</td>
</tr>
<tr>
<td>Manufacturing production</td>
<td>0.1198</td>
</tr>
<tr>
<td>Utilities production</td>
<td>0.0517</td>
</tr>
<tr>
<td>Construction</td>
<td>0.0867</td>
</tr>
<tr>
<td>Transportation sales</td>
<td>0.1112</td>
</tr>
<tr>
<td>Retail trade</td>
<td>0.0500</td>
</tr>
<tr>
<td>Nominal merchandise exports</td>
<td>0.1200</td>
</tr>
<tr>
<td>Nominal merchandise imports</td>
<td>0.1395</td>
</tr>
<tr>
<td>Nominal M2</td>
<td>0.0145</td>
</tr>
<tr>
<td>Nominal average industrial wage</td>
<td>0.0562</td>
</tr>
<tr>
<td>Transportation and communication prices</td>
<td>0.0134</td>
</tr>
<tr>
<td>Industrial producer prices</td>
<td>0.0991</td>
</tr>
<tr>
<td>Agricultural producer prices</td>
<td>0.1076</td>
</tr>
<tr>
<td>Construction prices</td>
<td>0.0263</td>
</tr>
<tr>
<td>Consumer prices</td>
<td>0.0398</td>
</tr>
<tr>
<td>Nominal koruna/U.S. dollar exchange rate</td>
<td>0.0648</td>
</tr>
<tr>
<td>Nominal koruna/euro exchange rate</td>
<td>0.0430</td>
</tr>
<tr>
<td>Business confidence index</td>
<td>0.0856</td>
</tr>
</tbody>
</table>
Andrei Roudoi

Vita

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