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IMPLICATIONS OF FOOD SAFETY AND QUALITY STANDARDS:

INSIGHTS FROM TURKISH TOMATO EXPORTS

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ABSTRACT

Global trade system is witnessing an unprecedented increase in food safety and quality standards. Changes in the structure of the world trade affect the welfare of farmers and consumers, destinations of exports, and the dynamics behind the exporters' compliance decisions with these non-tariff barriers to trade. This dissertation consists of three related essays.

In the first essay, a partial equilibrium model of tomato trade from Turkey to European Union countries is developed to examine the combined effects of quality and safety standards and price-dependent barriers to trade such as minimum import prices for imports. This essay also incorporates the heterogeneous preference structure of consumers in the EU, i.e., consumers are distinguished by their concern over the potential negative effects of their consumption of tomatoes. The results indicate that minimum entry price enforcement has a positive effect on producer welfare in the importing country, and negative effect on consumer welfare in the importing country and producer welfare in the exporting country if applied with non-tariff barriers.

In the second essay, a Markov Chain Analysis is used to examine changes in the destination markets of the Turkish tomato exports and whether these can be linked to trade standards. A Markov probability transition matrix is estimated and suggests that transition probabilities are higher from high standard to medium and low standard countries. On the other hand, there is almost zero probability of transition from low and medium standard groups to the high standard group in terms of food safety and quality.

In the third essay, exporters' decision on whether or not to comply with an importer's requirements is examined by focusing on a representative Turkish tomato exporter's decision problem in two different markets in terms of their enforcements of the safety and quality requirements: the EU and Russia. Two dynamic decision models are developed for two different markets. In the EU market, the exporter faces a discrete choice of either complying or non-complying with the existing standards; hence, a discrete model of compliance is used. In the Russian market, the application of standards is such that the exporter can choose the level of compliance, hence, a continuous model of compliance is used. Results suggest that Turkish tomato exporters who focus on EU markets are likely to be more cautious in terms of compliance than the ones who send their produce to the Russian Federation.

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INTRODUCTION

Introduction

A period of increasing enforcement of food safety and quality standards by importing countries has coincided with the implementation of the Sanitary and Phyto-sanitary (SPS) Agreement under the Uruguay Round Agreement in 1994 that established the World Trade Organization (WTO). Although WTO member countries came to an agreement "desiring the establishment of a multilateral framework of rules and disciplines to guide the development, adoption, and enforcement of SPS measures in order to minimize their negative effects on trade", each importing country can still determine its own standards. What's more, despite efforts to ensure that any standard being applied is based on sufficient scientific evidence, exporting countries constantly complain about their political nature and inconsistent usage. Assuring the validity of standards is even more difficult if an importing country is not a member of a central trade regulating body, such as the WTO, because the importer is not required to comply with the SPS Agreement and exporters cannot refer a dispute to the WTO if they believe that the other party is violating its own laws.

Fresh fruit and vegetables are among the most vulnerable category of products to SPS measures due to their perishable nature, regular contact with other living organisms, and farmers' inevitable use of pesticides to maintain yields, and product quality. Pesticide residues may have negative effects on health which show up only after some period following consumption. The consumer might not even be able to distinguish the source of a health problem. Consumers may continue to buy the same products without knowing the quality of these products. Some consumers may demand that lower quality[1] foods be identified in the market and choose to consume the ones they perceive as less risky even if these are offered at higher prices. That is to say, in the real world, consumers value lower and higher quality products differently and may have a different willingness to pay (WTP) for the same product.

[1] A less risky product in terms of human health is considered as higher quality in terms of consumer perspective.

Moreover, despite the enforcement of higher SPS standards and their harmonization across countries, consumers might perceive the products produced in their own country to be superior to imported ones and be willing to pay more for domestic produce. A labeling policy which makes the country of origin explicit to buyers is therefore preferred by domestic producers in the importing country. Given the heterogeneous preferences of consumers, the welfare implications of such labeling policies are different between various groups of consumers. Turkey, as a major fresh produce exporting country is seriously affected by the changing nature of trade barriers relating to health and safety issues.

Due to its favorable geographical condition (climate, water and land resources), many varieties of fruit and vegetables can be grown in different parts of Turkey, especially along the Aegean and Mediterranean coast lines. In fact, Turkey produces 80 types of fresh fruit and vegetables out of 140 major commercial products grown in the world. Out of these, 50 varieties are exported. However, in terms of volume, only 2% of the total vegetable production is exported. Tomatoes constitute 36-40% of the country's total vegetable production and 50% of its total vegetable exports (UN FAO 2010).

Russia and the European Union (EU) are major target markets for Turkish tomato exporters because of their close location and preferential access granted to Turkey by the European Union[2]. Turkish fresh produce exporters face barriers to entry in the form of tariff, non tariff and price dependent measures both in Russia and the European Union. However, the importance and nature of these barriers differ. In EU markets, Turkish tomato exporters face competition from Spain, Greece and Morocco, strengthened by the preferential status offered by the EU to Morocco[3], and barrier-free trade between Spain, Greece and all other EU countries, as Spain and Greece are EU members. On the other hand, the lack of

[2] Although the EU established a Customs Union with Turkey in 1995, trade in agriculture and steel products is regulated by separate bilateral preferential agreements. The European Commission (EC)-Turkey trade agreement for agricultural products of 1998 removed ad- valorem tariffs on fresh fruit and vegetables as long as entry prices are lower than the minimum entry prices set by the EU.
[3] Minimum entry prices on fresh fruit and vegetables are set lower for Morocco.

harmonization between Russian and EU standards, Russia's stricter requirements on maximum residue levels (MRLs) for pesticides, and inconsistent applications of the rules are the main problems faced by Turkish exporters in Russian markets. Although Russian standards are nominally stricter, enforcement is weak and there are illegal mechanisms which can minimize exporters' loss in case a failure to meet these standards. Most of the time, even if produce is rejected at the Russian border Turkish exporters have the option of redirecting consignments to nearby countries with weaker standards. That is to say, the risk of rejection or risk of destruction in case of rejection is weak due to gaps in the enforcement of trade laws in Russia. This substantial heterogeneity of trade policies and enforcement levels between two top export destinations of Turkish tomatoes has the potential to result in a shift of exports, particularly when combined with individual exporters' strengths and weaknesses, such as the tomato sector's small-scale production structure, the inadequacy of farmers' organizations (especially in relation to the marketing of their produce), farmers' short term, non-contractual relationships with potential buyers, the lack of storage facilities causing high production losses, slow improvement at the farm level in complying with requirements for good agriculture practices, etc.

Because of the difficulty of ensuring compliance with standards at the production level, the use of strategies to avoid rejection of their exports and avoidance of compliance costs are tendencies among Turkish exporters. The frequency of these tendencies depends on the risk of being caught, which in turn depends on the destination country (since these differ in terms of the actual enforcement of standards).

The aim of this dissertation is to provide insights into quality and safety standards in importing markets and their implications for Turkish tomato exporters. A summary of objectives is presented next followed by a detailed description of key features of the market situation faced by Turkish tomato exporters.

Objectives

This dissertation consists of three essays which fulfill three different but related research objectives.

As noted earlier, the global trade system is witnessing an unprecedented increase in food safety and quality standards. Changes in world trade arena undoubtedly affect the welfare of farmers (in both importing and exporting countries) and households. The first essay in this dissertation focuses on changes in the welfare of all related agents brought by the imposition of quality and safety standards in the context of existing trade measures, in particular minimum import price in the European Union requirements. Apart from incorporating the affected agents, to provide a more complete analysis of total welfare loss or gain, this essay incorporates heterogeneous preference structures of consumers in the importing country: i.e., consumers are distinguished by their concern over the potential negative effects of their consumption of a given product. The welfare implications of a country of origin labeling requirement by the importer are examined. A key issue is the effect of interactions between the EU's high quality standards and its minimum entry price for imports, and its heterogeneous consumer profile.

A partial equilibrium model of fresh food trade between two countries is used to measure the potential impact of the quality standards in the importing country. The model incorporates producers from both countries as well as consumers in the importing country and their heterogeneous preferences. The model is used to examine the combined effects of quality standards and price-dependent barriers to trade such as minimum entry prices for imports. Evaluating the welfare consequences of these combined measures numerically is important for assessing the impact of quality standards in importing countries where other barriers to trade are applied.

The partial equilibrium model is applied to imports of Turkish tomatoes in EU countries, as these countries are known to be very strict in terms of the enforcement of food safety and quality standards (i.e., an exporter has no other choice but to meet these standards in order to enter EU markets) and EU consumers tend to be well educated and relatively health conscious. On top of strict quality and safety standards, the EU has a tradition of applying minimum import prices for imported fruit and vegetables to protect domestic producers. The possible interactions between the two different policy instruments (standards and minimum import prices) should not be ignored if the objective is to provide a realistic assessment picture of the consequences of their application.

Differences in the actual enforcement levels of standards in potential destination markets were noted earlier. Russia has stricter standards for MRLs but handling the situation if non-compliance is detected is easier for Turkish exporters as there are other candidate markets nearby to redirect consignments and it is possible to use some other mechanisms, particularly bribes, to ensure the acceptance of consignment. Such differences between major destination markets may well have influenced the evolution of the share of Turkish tomatoes exported to different markets.

Consequently, the objective of the second essay is to examine changes in the destination of the Turkish fresh tomato exports and whether these can be linked to trade standards. To accomplish this, changes in the tomato export structure during the period from 1994 to 2009 is analyzed using a Markov Chain Model. Using aggregate frequency data of exports in each exporting year, approximations to firm level behavior under similar circumstances are estimated. Analyzing the nature of changes in the share of exports among target destinations (i.e., their persistency, significance, etc.) and the factors which may give rise to these changes could help Turkish exporters in developing future policies.

Differing enforcement levels for standards is expected to cause differences in compliance behavior among firms. Determining optimal compliance behavior in alternative markets through the use of a single decision model applicable to all circumstances is extremely challenging. For example, an exporter whose destination market is Russia could possibly alter the level of compliance in the light of the expected probability of the likelihood of detection and subsequent destruction, given alternative markets available to redirect produce. The decision available to Turkish tomato exporters whose target market is Russia is more complex than the two choices for EU markets: compliance or non-compliance. On the other hand, the variety of choices in the Russian market might be offset by higher profits in the EU market under compliance. The disparity between the two major destination markets implies two different decision models, resulting in different optimal decision rules.

Thus, the third research objective is to examine an exporter's decision on whether or not to comply with the importer's requirements. In other words, this essay discusses the costs and benefits of compliance and their ranking in alternative markets. A dynamic optimization model is developed to consider the specific characteristics of each destination market and to examine the optimal behavior of exporters subject to requirements that involve high compliance costs.

Determining the Key Features of the Market Situation Faced by Turkish Tomato Exporters

To determine the conditions facing Turkish exporters in foreign markets, several fresh produce (mainly tomato) exporters were identified and contacted in Turkey. In depth interviews were conducted with the identified exporter firms at the managerial level. Firms were approached on the basis of their export focus (EU or Russia) to find out the differences faced in the market situations of these countries. Additional interviews were conducted with experts from fresh fruit and vegetables exporters' unions in Turkey (i.e., the Mediterranean Fresh Fruit and Vegetables Exporters Union, Aegean Fresh Fruit and Vegetables Exporters Union, and the Antalya Fresh Fruit and Vegetables Exporters Union), country-level specialists at the Turkish Exporters' Assembly (TIM) and experts from private agricultural consulting firms, long haul transportation firms, universities and farmers. The interviews were conducted between June and December 2009 through visits to selected firms and organizations located in Izmir, Antalya and Mersin provinces. Very few interviews could be conducted using the telephone or using web connections due to reluctance of interviewees to respond other than through face-to-face meetings.

Respondents were asked questions about a series of possible impediments to their trade previously identified in the literature (Koc 2007; Keskin, Ozdogru, and Nazli 2009; Yilmaz, Sayin, and Ozkan 2005; Garcia-Alvarez-Coque and Jordán-Galduf 2007; and United States Department of Agriculture (USDA) Foreign Agricultural Service (FAS) 2009). Questions focused on the situation in Turkey in terms of production and supply chain relationships, competition and profitability in the destination markets, logistics and trade restrictions. The first conclusion reached was the concentration on a single market by each exporter. No firm was encountered that exported both to Russia and the EU. This was a strong indicator that the situation faced by exporters in the two markets is quite different, and that export decisions are also likely to be quite different.

All exporters to the EU agreed that Spain and Morocco together compete with Turkish tomato exporters in the European market. For example, other than lower transportation costs due its location advantage, Spanish tomatoes have advantages over those from Turkey. Spain is an EU member country and faces none of the tariff or non tariff barriers that apply to non-EU suppliers. On the other hand, Morocco and Turkey are not significantly different from each other in terms of their location. But, although it is not an EU Member, Morocco enjoys preferential, lower entry prices putting Turkish exporters at a competitive disadvantage. As one Turkish exporter put it: "Morocco operates like a European base." Both Moroccan and Turkish exporters face various non-tariff trade barriers in EU markets, the most serious one being the high level of quality standards and their interaction with the minimum import price (MIP) regime. Although the latter is applied on imports from both countries, a different set of MIPs is used for imports from Morocco and these are lower than the ones applied on the same items coming from Turkey. Turkish exporters expressed the opinion that the EU discriminates between Morocco and Turkey in favor of Moroccan suppliers in applying the standard non-tariff measures, although both are non-EU countries. Based on these from Turkish exporter responses, the potential impact of quality standards in the EU and their interaction with the MIP for Turkish tomato exporters was considered to merit further investigation.

There are some other EU countries that produce tomatoes that are not significant for Turkish exporters: In 2007 and 2008, Italy was the sixth largest tomato producer in the world according to most recent FAO crop statistics, followed very closely by Spain (eighth in the world) (UN FAO 2010). Greece, Portugal, France, Netherlands and Belgium are other major tomato producers within the EU. Roughly 80% to 90% of total production in Italy is for industrial purposes and the remaining fresh tomatoes are mainly consumed domestically. Italy is not a significant supplier of fresh tomatoes to other EU countries despite its high production. Increasing home consumption of fresh tomatoes is being met by imports.

Harvest seasons, varieties produced and production methods vary across tomato producing countries in the EU and this affects the competitiveness of non-EU suppliers. The intensity of competition in the EU market varies throughout the year, reaching a peak in December through March; these are also the peak months for Turkish exports. Spanish tomato production is export market oriented in the winter months when other producers in the EU, i.e., Sweden, Finland, Germany, Slovenia, and the UK are at a competitive disadvantage due to their climate. Germany is the principal destination for Spanish tomato exports, followed by the Netherlands, UK, and France. One of the most important features of Spanish tomato exports is their concentration in markets with relatively high purchasing power (Valenciano and Mesa 2004). Due to its lower production cost and a preferential trade agreement, Morocco competes with Spain within the EU.

Figure 1 Map of Turkey
Source: Google Maps 2010

The Russian Federation is an increasingly important market for Turkish tomato exporters accounting for more than 50% of total exports in recent years (TurkStat 2010). Turkey harvests and exports its fresh tomatoes approximately between October 15 and June 22, mostly from greenhouse facilities concentrated in Antalya province, which is located in the south of Turkey, by the Mediterranean Sea (see Figure 1 above)

Starting in June, when Turkish exporters are out of the Russian market, the main suppliers are Poland and Azerbaijan. Only if the temperature allows in the summer, i.e., if it is not too warm, from August 15 to September 15, early field tomatoes produced in the uplands of Antalya might be transported to Russian markets. The majority of the exporters interviewed felt that the discrepancy in the timing of harvest protects Turkey from aggressive competition from other tomato exporters in Russia. Turkey also has a locational advantage as its tomatoes can be transported by sea; almost all tomato exports are transported via the Black Sea route, between Trabzon in Turkey and Sochi in Russia (see Figure 1 above).

Both exporters and agricultural advising firms working with exporters shared the view that pesticide residues are a major concern for Turkish tomato exporters, followed by quality-related concerns. As a result of the interviews this issue emerged as a significant difference between the EU and Russian markets. The Russian MRLs are much lower than those for the EU; some being virtually impossible to attain. This has already disrupted some traditional Turkish exports to Russia, such as courgettes (zucchini). Turkish tomato exporters complain that Russian inspections and border rejections can be political and unsystematic. The most recent significant dispute began on May 30, 2008, when Russia's Rosselkhoznadzor (Federal Veterinary and Phyto-sanitary Control Service), announced that it would halt Turkish agricultural imports beginning on June 7, 2008 after discovering elevated levels of chemical fertilizer and pesticides in certain products, including tomatoes. Rosselkhoznadzor stated that since the beginning of 2008, approximately 4 million tons of Turkish agricultural imports had been found to contain pesticides and nitrate traces in "amounts significantly exceeding the maximum permitted levels set by Russian law" (Daly 2008, electronic version of Eurasian Daily Monitor Journal). The recent incident adds a sense of deja-vu, as in May 2005 Moscow also suddenly halted imports of Turkish produce. Turkey lost approximately $220 million in exports over a four month period. A similar crisis threatened in 2006 but was averted at the last moment through high-level ministerial talks. Few observers believe that such crises are due to increased concerns about the health of Russian citizens. Instead, it is argued that the decision was political; representing a strategic response to Turkey's expressed interest in establishing itself as a transit corridor for Caspian oil[4] and natural gas exports.

Exporters to EU countries report that fresh fruit and vegetables with quality certification provided by independent parties receive better treatment at the European Union border. The Global Partnership for Good Agricultural Practice (GLOBALGAP, formerly EurepGAP) is a widely recognized standard for business-to-business trade in farm produce, mainly within the EU. GLOBALGAP is a pre-farm-gate standard, which means that certification covers the use of farm inputs like feed or seedlings, agro-chemicals, and all the farming activities until the product leaves the farm. GLOBALGAP involves annual inspections of producers and additional unannounced inspections. Although not legally required, exporters are aware that a key requirement for exporting to European markets is GLOBALGAP certification because these markets are dominated by supermarkets that typically require this from their suppliers. Exporters and experts in the Turkish tomato industry believe that certification decreases export risks for EU markets, as certified products are rarely inspected at the border.

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[4] The Azerbaijan-Georgia-Turkey corridor is set to become the major route for the transport of Caspian oil to Western markets. As Russia's foreign currency revenues comes mainly from oil and gas sales, Russian foreign policy and energy establishments view Caspian oil and natural gas producing and transiting countries such as Kazakhstan, Turkmenistan, Azerbaijan and Georgia as major competitors for Russian energy exports to European markets.

A similar structure that might serve as a pre-transport indicator of quality was introduced for the Russian market in May 2006. The Turkish Ministry of Agriculture requires all fresh fruit and vegetable products for export to the Russian Federation to have a food safety certificate. Certificates are issued by control laboratories located in the provinces that test for pesticide residues or other sources of contamination. Although this might serve as a risk-reducing mechanism for Turkish exports to Russia (as transport costs will no longer be incurred for products denied entry at the border due to inspections), it might also be seen as an impediment for exporters. Exporters to the Russian Federation complain that the control process takes at least 3 days and that this shortens the shelf life of products. Interviews conducted with the experts at the Turkish Ministry of Agriculture suggested that currently 20% to 30% of the products arriving for control at the laboratories are found to violate Russian standards on food safety and are not given a certificate.

All those interviewed in Turkey who is knowledgeable about the tomato trade agree that no matter how stringent the legislation might seem, bureaucratic corruption and the activities of certain illegal organizations compromise the actual stringency of Russian standards on imported produce. In some cases, an inspector might shut his/her eyes to a consignment that does not meet the required standards. Researchers in public and private institutes who were interviewed suggested that corruption can arise from the activities of Turkish firms who act as wholesalers in the Russian terminal markets and work in coordination with Turkish exporters. This often means that they buy whatever the exporter offers at a given price, without paying much attention to quality. As a last resort, exports that are denied entry at the Russian border are redirected to Bulgaria or Romania, for re-export to Russia. Observing this trend among Turkish exporters, the Russian Government recently banned the importation of fresh fruit and vegetables produced in Turkey from Bulgaria, but the regulation is not actually enforced given the difficulty of verifying the country of origin.

Even if such re-exporting can not be achieved, exporters can still ship rejected products back for sales in the domestic market (given corruption and a lack of inspections in Turkey) to cover some of their costs. All these practices constitute a serious impediment to achieving progress in quality enforcement in the Turkish tomato industry although they might generate short term profits. In the light of the differing applications of standards between markets, it is possible that exporters will choose to shift their produce over time to markets in which standards are less strict in practice and entrance is easier. This issue is addressed in the second essay of this dissertation.

The EU and Russian tomato export markets are not only different in terms of competition levels and the enforcement of standards but also their impact on farmer-exporter dynamics within Turkey. Turkish tomato farmers rarely sell their produce directly into the domestic or export markets. Produce is bought by intermediaries who are generally also exporters. Farm prices are determined in terminal markets. The Turkish Ministry of Agriculture requires farmers to comply with minimum product safety and quality standards, but these are not fully enforced. An exporter rarely invests in testing the produce for pesticide residues before making a buying decision. This would be costly and difficult given that a truckload of tomatoes may contain products from 15 to 20 different farms and the testing procedure would have to be applied for each of these. Exporters try to reduce the risks involved by buying repeatedly from the same trusted farmers. Furthermore, exporters are increasingly interested in producing their own produce to reduce the risks and associated costs of substandard products, particularly for export to the EU.

Although the legislation governing pesticide residues in fresh produce entering the country is nominally stricter in the Russian Federation, actual enforcement practices suggest that it is easier for Turkish exporters to evade the Russian standards. While none of those interviewed considered the Russian market to be unprofitable, higher profits for the EU market are reported. Industry experts attributed this to high volumes, strong marketing structures, competitive agents, high prices and the requirement for highly specialized products. On the other hand, the EU market is considered to be more competitive than the Russian market and also one that involves relatively higher establishment and operational costs. Supply shortages for top quality tomatoes due to non-contractual relationships, small-scale, highly fragmented farms ineffectively employing technology are some of the factors that constrain the development of the export business with the EU market. These concerns are less relevant for the Russian market as there are more alternative markets to which produce can be redirected in case of rejection; and, as noted earlier, rejection of consignments at the Russian border is unlikely due to illegal mechanisms used by exporters to overcome non-compliance. The differing consequences in the application of product standards in these markets are expected to affect the compliance behavior of exporters. This issue is examined in the third essay of this dissertation.

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ESSAY 1

Non-Tariff Barriers to Fresh Produce Trade: Welfare Implications under Heterogeneous Consumer Preferences

1.1 Introduction

With increased international integration, trade is increasingly becoming a vector of external effects, and governments have responded with a wide array of non-tariff barriers (NTBs) to satisfy domestic concerns (Levine and D'Antonio 2003). Domestic concerns are either raised by farmers or sellers at different levels in the food system or by the consumers. The agricultural sector has been subject to a sustained process of technological change resulting in decreasing marginal costs of production and farmers have sought policies, including trade policies to try to protect their incomes and to slow the process of adjustment to competitive pressures (Hobbs and Kerr 2006). However, in recent years, the protection for consumers has also become more prominent in the policy agenda as a series of food crises have reduced consumer confidence in the safety of the food they consume (e.g., the emergence of bovine spongiform encephalopathy (BSE, commonly known as mad-cow disease) and food and mouth disease which both originated in the UK; dioxin contamination originated in Belgium and cooking oil contamination in Spain). Technical catastrophes like the one in Chernobyl also affected the safety of the products produced in certain regions of the world; the emergence of genetically modified (GM) produce and other technical innovations in the food system have also raised consumer awareness about potential health risks of food consumption. Currently, this awareness includes but is not limited to chemical residues in fruit and vegetables due to the use of pesticides and fertilizers and drug and growth hormone residues in meat. Currently, more than 40 different food-borne microbial pathogens are known to cause sickness in humans (Buzby, Frenzen, and Rasco 2001). Policymakers, producers, and retailers alike are now trying to regain consumers' confidence by redesigning legislation to address food production methods and food safety issues (Roosen 2003). The EU White Paper on safety (Commission of the European Communities 2000) that underpins the creation of the European Food Safety Agency (EFSA) is one of the specific results of these efforts in the EU. At the international level the creation of the Sanitary and Phyto-sanitary (SPS) Agreement, an activity of the WTO, is a reflection of increased activity in this area.

Perceptions of food safety and quality depend on consumers' attitudes and beliefs; and they may differ among individuals and households even in the same society. Some individuals may be willing to pay for decreasing the risks involved in food consumption. If perceptions of food safety differ, willingness to pay (WTP) for increased food safety or decreased food safety risk is also likely to differ. In the context of international trade an investigation of how different consumers value domestic and imported types of the same produce is of interest if one is to conduct a welfare analysis of food safety policies.

It is likely that some EU consumers are in favor of consuming domestically produced goods rather than imported ones. This is because these consumers perceive European produce as being of higher quality and this will typically increase their WTP if both imported and domestic varieties are on the market providing they can distinguish between the two. In 1992, the EU published a set of rules and related certifications for promoting and protecting agricultural and food products linked to a specific place of origin (European Commission 1998). One of the objectives of the regulation was to help consumers by giving them information on the specific character of the products. This regulation assumes that the perceived utility of certain products increases for quality-seeking consumers if they are aware of a product's origin and the production methods used (Van der Lans et al. 2001). The way used to communicate such information to consumers is product labeling. In theory, labeling should prevent information asymmetries between producers and consumers.

Apart from using measures such as labeling mainly to increase its consumers' welfare, the EU also uses policies that are intended to protect domestic producers from increased competition from lower priced imports. Tariffs have been a traditional way to protect domestic producers from import competition, but in the area of fruit and vegetables price-dependent tariffs have been particularly important (i.e., the MIP approach). A close investigation of the entry price system of the EU is essential for a complete review of EU trade regime for fresh produce.

The entry price system covers fruit and vegetable products considered to be "sensitive" by the EU. The system replaced the former "reference price system" (applied until June 30, 1995) due to new rules under the Uruguay Agreement of the WTO (details of the former reference price system and its comparison with the entry price system can be found in Swinbank and Ritson 1995; Grethe and Tangermann 1999).

The current system essentially imposes a two tiered tariff. An entry price is specified for each product covered under the regime. For any import whose cost-insurance-freight (c.i.f) price is above this pre-determined entry price, the regular ad-valorem tariff is applied. However, when the c.i.f price is below this entry price, exporters have to pay an additional specific duty together with the ad valorem tariff. Furthermore, the amount of the specific tariff increases as the gap between the entry and c.i.f prices increases. The aim of the system is to prevent "the entry of cheap products that erode the market competitiveness of EU products" (Garcia-Alvarez-Coque and Martinez-Gomez 2007). The rule is that when the c.i.f. price is 92% of the entry price or more, the exporter's specific duty is the gap between the entry price and the c.i.f. price. However, whenever the c.i.f. price is less than 92% of the entry price, the exporter must pay what is called the "maximum tariff equivalent (MTE)". In that case, the MTEs are almost always prohibitive tariffs. Specific tariffs are charged per individual shipment, that is to say, if the c.i.f. price of one shipment is below the entry price, this will not affect other shipments from the same origin. According to Grethe and Tangermann (1999) this aspect reduces the protective effect of the entry price system.

Another important aspect of the entry price system is the determination of c.i.f. prices - technically called standard import values (SIV). The European Commission calculates a daily c.i.f. value by country of origin and exporters are given the right to check the compliance of their prices with commission-determined SIVs (daily SIVs are open to the public through the Integrated Tariff of the European Communities (TARIC) database). Entry prices and tariffs change seasonally to adjust their protective nature according to the perceived needs of domestic EU producers (see Table 1.1).

Both non-tariff measures and entry price based measures work together to affect EU imports of tomatoes from Turkey, what is more, these measures may interact with each other, intensifying trade distorting effects and causing welfare losses for exporters. An exporter may comply with all quality and safety standards and even country of origin labeling; but still violate the MIP at the border, forcing the exporter to pay tariffs as penalties for MIP violation, thereby nullifying the very high costs incurred in compliance.

Table 1.1 Tariff schedule for fruit and vegetables subject to EU entry price (EP) scheme

Description	Most favored nation tariff	Preferential tariff	EP system period	Entry prices	MTE
	(%)	(%)	(day.month - day.month)	(€ / 100 kg)	(€ / 100 □kg)
Apples	0.4 and 9	0	01.01 - 31.12	45.7 and 56.8	23.8
Apricots	2□	0	01.06 - 31.07	77.1 and 107.1	22.7
Artichokes (Globe)	10.4	0	01.11 - 30.06	65.4, 82.6 and 94.3	22.9
Cherries	12	0	01.05 - 10.08	125.4 and 149	27
Clementine□	16	0	01.11 - 28.02□	28.6	10.6
Courgettes	12.8	0	01.01 - 31.12	41.3, 48.8 and 69.2	15.2
Cucumbers	12.8 and 16	0	01.01 - 31.12	34.3, 60.5, 67.5, 68.3 and 110.5	37.8
Lemons	6.4	0	01.01 - 31.12	46.2 and 55.8	25.6
Oranges	3.2, 4.8, 10.4 and 16	0	01.12 - 31.05	35.4	7.1
Peaches	17.6	0	11.06 - 30.09	77.6 and 88.3	13
Pears	0, 2.5, 5 and 10.4	0	01.07 - 30.04	38.8, 45.6 and 51	23.8
Plums	6.4 and 12	0	11.06 - 30.09	69.6	10.3
Table Grapes (Seedless)	8, 11.50, 14.1 and 17.6	0	21.07 - 20.11	47.6 and 54.6	9.6
Tomatoes	8.8 and 14.4	0	01.01 - 31.12	52.6, 72.6, 84.6 and 112.6	29.8

Source: European Commission 2010

This essay focuses on the Turkish tomato exports to EU countries to evaluate the welfare consequences of quality standards and minimum import prices to Turkish and EU farmers and different segments of EU consumers. Due to the significance of differences in consumer perceptions and the information conveyed through labeling, special emphasis is given to these details in developing a partial equilibrium model to determine the welfare calculus.

In the following section, a general partial equilibrium model is developed to evaluate welfare changes under non-tariff and import price-dependent trade measures, taking into account the existence of heterogeneous groups of consumers in the importing country. This model is then applied to EU imports of fresh tomatoes from Turkey.

1.2 Analytical framework

The model outlined below deals with trade in a single product between two countries (or between an exporter and a group of importing countries operating a common trade regime). It is useful to note from the start that the abbreviation "exp" will be used to denote the exporting country and "imp" to denote the importing country.

The demand function for the particular product in the importing country is formulated as follows:

$$Q^{D\_imp} = f(P^{R\_imp}) = \alpha^{D\_imp} - \beta^{D\_imp} P^{R\_imp} \quad . \qquad 1.1$$

In the above equation, the price P^{R_imp} is defined at the retail level in the importing country. Similarly, the domestic supply function (at the retail level) is written as:

$$Q^{S\_imp} = f(P^{R\_imp}) = \alpha^{S\_imp} + \beta^{S\_imp} P^{R\_imp} \quad . \qquad 1.2$$

The product is traded between these countries as the domestic demand in the importing country is larger than its domestic supply. The difference between the domestic demand and supply is satisfied by product from the exporter (i.e., export supply), Q^{S_exp}, such that:

$$Q^{S\_exp} = \alpha^{S\_exp} + \beta^{S\_exp} P^{W\_exp} \quad . \tag{1.3}$$

Using equations 1.1, 1.2, and 1.3,

$$Q^{D\_imp} - Q^{S\_imp} = Q^{S\_exp} \quad . \tag{1.4}$$

In this model, the export supply function is defined at the wholesale level (i.e., P^{W_exp}).

Although the prices in the model are defined at different levels, if the margins (assumed constant here) between different levels of marketing are known, any price can be expressed in terms any other at a different market level. One can then substitute these prices into the demand and supply functions.

Export prices and export quantities are determined by the demand and supply conditions in the importing country, therefore, export prices (at the wholesale level) can be expressed as a function of the prices (at the retail level) in the importing country such that:

$$P^{W\_exp} = f(P^{R\_imp}) \quad .$$

$$P^{W\_exp} = P^{R\_imp} - M_1 \quad . \tag{1.5}$$

M_1 is the constant margin between retail prices in the importer and wholesale prices at the exporter country. Similarly, if we can assume that a constant margin exists between retailer and farm prices in the importing country:

$$P^{F\_imp} = f(P^{R\_imp}) \quad ,$$

$$P^{F\_imp} = P^{R\_imp} - M_2 \quad , \tag{1.6}$$

where M_2 is the constant margin between retail and farm prices in the importing country.

1.2.1 Welfare under autarky

To provide an initial point of reference let us consider the situation in which a country is self-sufficient in the particular product and thus not participating in trade. Autarky could be created by prohibitively high transport costs or due to some non-tariff barrier (i.e., a prohibitive measure), that totally prohibits the entrance of produce from other countries. Here, only the domestic supply/demand relations need to be considered since the foreign product is not available. Letting domestic supply be equal to domestic demand, quantity supplied/demanded, and retail/farm level prices can be estimated. Finally, using these estimations, consumer and producer welfare can be computed.

Market clearing condition under autarky equalizes equations 1.1 and 1.2:

$$Q^{D\_imp} = Q^{S\_imp} \ ,$$

$$\alpha^{D\_imp} - \beta^{D\_imp} P^{R\_imp} = \alpha^{S\_imp} + \beta^{S\_imp} P^{R\_imp} \ ,$$

$$P^{R\_imp} = \frac{\alpha^{D\_imp} - \alpha^{S\_imp}}{\beta^{D\_imp} + \beta^{S\_imp}} = P_{AU} \ , \qquad 1.7$$

where P_{AU} denotes the market price under autarky. Then, substituting the market clearing price from equation 1.7 into equation 1.1 or 1.2,

$$Q^{D\_imp} = Q^{S\_imp} = \alpha^{D\_imp} - \beta^{D\_imp} \left(\frac{\alpha^{D\_imp} - \alpha^{S\_imp}}{\beta^{D\_imp} + \beta^{S\_imp}}\right) = \alpha^{S\_imp} + \beta^{S\_imp} \left(\frac{\alpha^{D\_imp} - \alpha^{S\_imp}}{\beta^{D\_imp} + \beta^{S\_imp}}\right) \ , \qquad 1.8$$

or if Q_{AU} denotes the equilibrium quantity under autarky,

$$Q_{AU} = \alpha^{D\_imp} - \beta^{D\_imp} P_{AU} \ . \qquad 1.9$$

Given the margin between retail-farm price in the importing country, assuming no losses in transferring the product from farms to retail markets (i.e., farmers' supply is equal to supply at the retail level); farmers' supply curve and thus, farmers' welfare is known.

It is known that $P^{R\_imp} = P^{F\_imp} + M_2$, and it is assumed that $Q^{S\_imp} = Q^{F\_imp}$

$$Q^{S\_imp} = f(P^{R\_imp}) = \alpha^{S\_imp} + \beta^{S\_imp} P^{R\_imp} \ ,$$

$$\Rightarrow \qquad P^{R\_imp} = \frac{Q^{S\_imp} - \alpha^{S\_imp}}{\beta^{S\_imp}} \ ,$$

$$= P^{F\_imp} + M_2 \ ,$$

$$\Rightarrow \qquad P^{F\_imp} = \frac{Q^{S\_imp} - \alpha^{S\_imp}}{\beta^{S\_imp}} - M_2 \ . \qquad 1.10$$

by substuting 1.10 into 1.2,

$$\Rightarrow \qquad Q^{S\_imp} = (\alpha^{S\_imp} + M_2\beta^{S\_imp}) + \beta^{S\_imp} P^{F\_imp} \ . \qquad 1.11$$

In the equation above, the retail supply curve is re-written in terms of the farmers' price. As previously stated, $Q^{S\_imp} = Q^{F\_imp}$ (i.e., farmers' supply is equal to supply at the retail level, without any loss), and the farmers' supply curve is:

$$Q^{FS\_imp} = (\alpha^{S\_imp} + M_2\beta^{S\_imp}) + \beta^{S\_imp} P^{F\_imp} \ . \qquad 1.12$$

Welfare measures are constructed next.

$PS_{AU}^{imp} = \int_0^{Q_{AU}} \left[(P_{AU} - M_2) - P^{F\_imp}(Q^{F\_imp}) \right] dQ$ is the farmers' economic surplus (hence, welfare)[5] , and,

$CS_{AU}^{imp} = \int_0^{Q_{AU}} \left[P^{R\_imp}(Q^{D\_imp}) - P_{AU} \right] dQ$ is consumers' economic surplus.

[5] Marshallian consumer and producer surplus estimations are used as an approximation for welfare changes in this study.

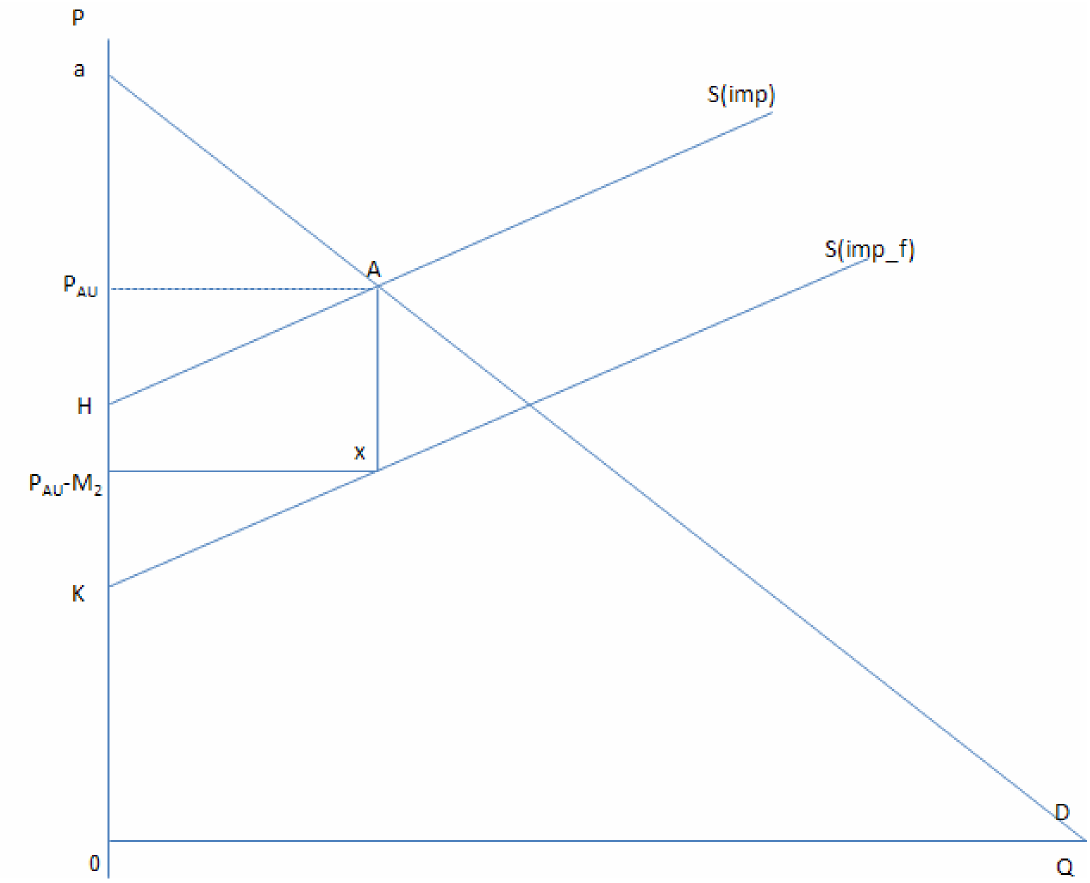

Figure 1.1 Autarky

In Figure 1.1, demand in the EU is D, domestic supply is S(imp), and domestic supply at the farm level is S(imp_f). Equilibrium price at retail and farm levels are denoted by P_{AU} and P_{AU}-M_2, respectively. Consumer surplus equals the area P_{AU}Aa and producer surplus is represented by the area Kx(P_{AU}-M_2). Total welfare under autarky for this country is therefore HAa (if measured at the retail level).

1.2.2 Welfare under free trade

To provide a second point of reference, the free trade case is analyzed next. Moving from an economy with no trade to free trade in a particular product; another source of supply flows into the country, namely the supply from an exporter. Aggregate supply, the sum of domestic and export supply (equation 1.1 plus 1.3) is offered to consumers in the importing country. Aggregate supply in the importing market is now denoted by Q_{FT}^{Ag} :

$$Q_{FT}^{Ag} = Q^{S\_imp} + Q^{S\_exp} \quad . \qquad 1.13$$

Recalling that the export supply function was defined at the exporting country's wholesale price level (i.e., $Q^{S\_exp} = \alpha^{S\_exp} + \beta^{S\_exp} P^{W\_exp}$), Q^{S_exp} should now be written as a function of the importer's price (using the relation already defined between P^{W_exp} and P^{R_imp}), to estimate the parameters of the aggregate supply curve:

$$Q^{S\_exp} = \alpha^{S\_exp} + \beta^{S\_exp} P^{W\_exp} \quad ,$$

$$\Rightarrow \qquad P^{W\_exp} = \frac{-\alpha^{S\_exp}}{\beta^{S\_exp}} + \frac{Q^{S\_exp}}{\beta^{S\_exp}} \quad ,$$

$$\Rightarrow \qquad P^{W\_exp} + M_1 = \frac{-\alpha^{S\_exp}}{\beta^{S\_exp}} + M_1 + \frac{1}{\beta^{S\_exp}} Q^{S\_exp} \quad . \qquad 1.14$$

as $P^{W\_exp} + M_1 = P^{R\_imp}$,

$$P^{R\_imp} = \frac{-\alpha^{S\_exp}}{\beta^{S\_exp}} + M_1 + \frac{1}{\beta^{S\_exp}} Q^{S\_exp} \quad ,$$

$$Q^{S\_exp} = \beta^{S\_exp} \left(P^{R\_imp} + \frac{\alpha^{S\_exp}}{\beta^{S\_exp}} - M_1\right) . \qquad 1.15$$

Equation 1.15 above is the export supply equation defined in terms of the price prevailing in the importing country. After this transformation, aggregate supply can be calculated as:

$$Q_{FT}^{Ag} = Q^{S\_imp} + Q^{S\_exp} = (\alpha^{S\_imp} + \beta^{S\_imp} P^{R\_imp}) + \beta^{S\_exp} \left(P^{R\_imp} + \frac{\alpha^{S\_exp}}{\beta^{S\_exp}} - M_1\right) \quad ,$$

$$= (\alpha^{S\_imp} + \alpha^{S\_exp} - \beta^{S\_exp} M_1) + (\beta^{S\_imp} + \beta^{S\_exp}) P^{R\_imp} \quad . \qquad 1.16$$

The market clearing identity equates aggregate supply to consumer demand in the importing country to determine equilibrium quantities and prices such that:

$Q_{FT}^{Ag} = Q^{D\_imp}$ (market clearing identity under free trade regime) ,

$(\alpha^{S\_imp} + \alpha^{S\_exp} - \beta^{S\_exp} M_1) + (\beta^{S\_imp} + \beta^{S\_exp}) P^{R\_imp} = \alpha^{D\_imp} - \beta^{D\_imp} P^{R\_imp}$,

$$(\alpha^{S\_imp} + \alpha^{S\_exp} - \beta^{S\_exp} M_1) - \alpha^{D\_imp} \; / - \beta^{D\_imp} + \beta^{S\_imp} + \beta^{S\_exp} = P^{R\_imp} = P_{FT} \; . \qquad 1.17$$

Substitution of P_{FT} into either the aggregate supply or the aggregate demand equation allows the aggregate quantity supplied under free trade to be determined. Let Turkish export supply at the equilibrium under free trade is denoted by $Q_{FT}^{S\_exp}$ and free trade equilibrium level of domestic producers' supply of the importing county be denoted by $Q_{FT}^{S\_imp}$. Next, welfare measures are constructed:

$PS_{FT}^{imp} = \int_0^{Q_{FT}^{S\_imp}} \left[((P_{FT} - M_2) - P^{F\_imp}(Q^{FS\_imp}))\right] dQ$ is the farmers' consumer surplus under free trade.

$CS_{FT}^{imp} = \int_0^{Q_{FT}^{S\_imp}} \left[P^{R\_imp}(Q^{D\_imp}) - P_{FT}\right] dQ$ is the consumer welfare under free trade.

In this case, there are also gains for exporters

$$PS_{FT}^{exp} = \int_0^{Q_{FT}^{S\_exp}} \left[(P_{FT} - M_1) - P^{W\_exp}(Q^{S\_exp}))\right] dQ \; .$$

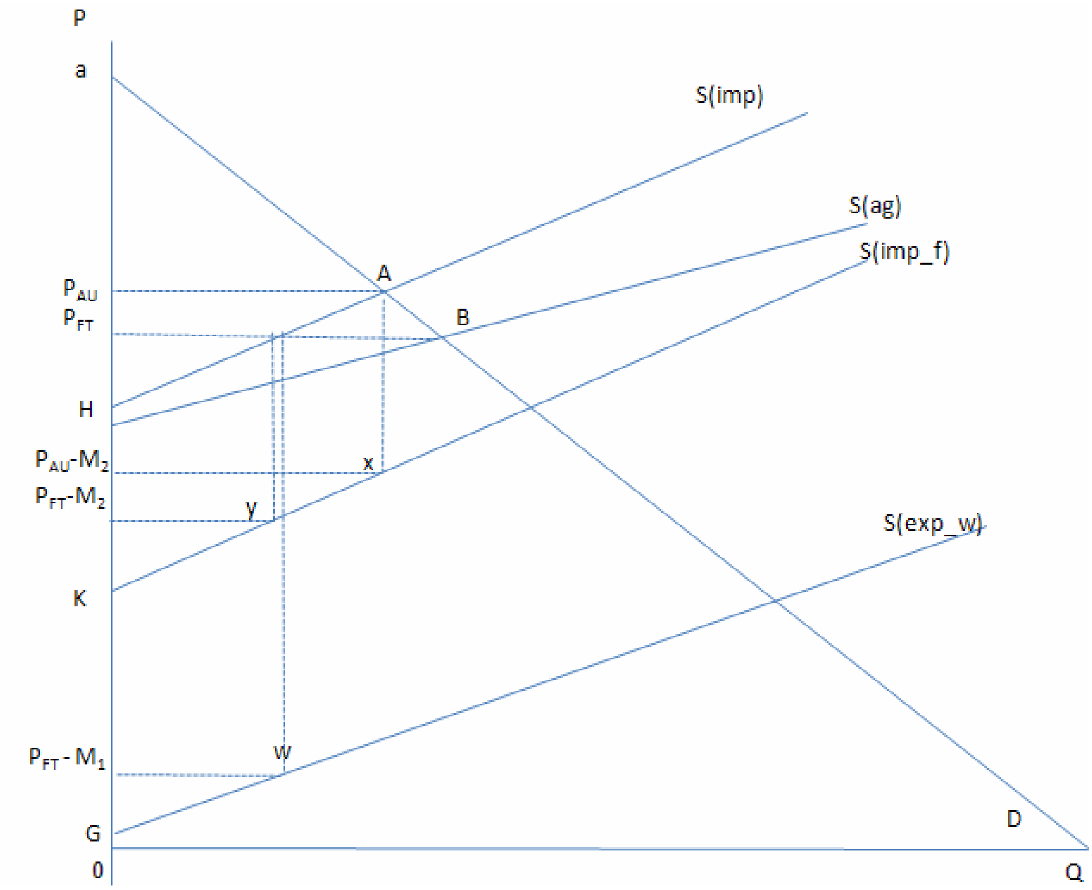

Figure 1.2 Free trade

In figure 1.2, S(exp_w) denotes the export supply at the wholesale level; S(ag) is the aggregate supply (horizontal sum of the S(imp) and S(exp_w); P_{FT} , P_{FT}-M_2, P_{FT}-M_1 are used for the equilibrium price at the retail and farm level in the importing country, and at the wholesale level in the exporting country, respectively. Producers' welfare is Ky(P_{FT}-M_2), which is clearly less than the area under autarky; Kx(P_{AU}-M_2). The area P_{FT}Ba is consumers' surplus, which is larger than the area P_{AU}Aa (the area representing consumer welfare under autarky). Under free trade, on the other hand, exporters' welfare at wholesale level is equal to the area Gw(P_{FT}-M_1).

1.2.3 Welfare under free trade with heterogeneous consumers

As mentioned in the introduction to this essay, perceptions of food safety and quality may differ between consumers in the same society. Some individuals may be willing to pay to decrease the risks involved in food consumption and such heterogeneity should be considered

to analyze consumer welfare. By the same token, if consumers are unable to distinguish lower from higher quality products (this is possible with no labels on products), the ones that are concerned about the risks and willing to pay more may value all products in the market less and stop consuming unless the price of products falls (to match their lower valuation).
The health-conscious group may also stop consuming the product altogether. These kinds of behavior by concerned consumers[6] will affect the welfare of all consumers, whether they are concerned or unconcerned about the quality status of the product offered. Because, there is no differentiation between higher or lower quality products under free trade, there is only one market for all products and these will be offered/purchased at the same price.

In both cases, the prevailing price in the domestic market is expected to decrease due to consumer responses mentioned in the above paragraph. This will affect the prices paid to exporters. If the decrease in export prices is sufficiently large, they might violate the minimum entry price designed to protect domestic producers. It is therefore important to consider the effect of minimum price enforcement on exporters' welfare under such a situation.

1.2.3 Decrease in demand of concerned consumers: k% decrease in the equilibrium price

To begin the analysis of the effects of heterogeneous preferences on welfare under free trade, it is assumed that concerned consumers value the marketed product k% less than the free trade equilibrium price. Therefore, total demand decreases until the price level reaches (1-k) % of the original. In other words, the new, shifted demand will be equal to (1-k)% of the aggregate supply at the free trade price.

Hence, $Q_{FT}^{Ag} = (\alpha^{S\_imp} + \alpha^{S\_exp} - \beta^{S\_exp} M_1) + (\beta^{S\_imp} + \beta^{S\_exp}) P^{R\_imp}$ (aggregate supply function) and under free trade, $Q_{FT}^{Ag} = (\alpha^{S\_imp} + \alpha^{S\_exp} - \beta^{S\_exp} M_1) + (\beta^{S\_imp} + \beta^{S\_exp}) P_{FT}$

[6] It is assumed that consumers can be partitioned into two groups and these groups are homogenous in preferences within themselves.

as $P^{R\_imp} = P_{FT}$ (the optimal domestic price under free trade is equal to P_{FT}).

$P^{R\_imp} = (1-(k/100))\ P_{FT}$ and therefore a parallel demand shift occurs such that aggregate supply is equal to demand at the price of $(1-(k/100))\ P_{FT}$ (i.e., k% of the free trade price of the previous section with homogeneity of consumers).

$$Q^{D\_imp\_k} = Q_{FT}^{Ag\_k} = (\alpha^{S\_imp} + \alpha^{S\_exp} - \beta^{S\_exp}\ M_1) + (\beta^{S\_imp} + \beta^{S\_exp})\ (1-(k/100))\ P_{FT}\ , \qquad 1.18$$

where $Q^{D\_imp\_k}$ and $Q_{FT}^{Ag\_k}$ are the quantity demanded and the quantity supplied, respectively, when price drops by k% from the free trade price.

Since, the new quantity demanded and the price are known together with the parameters of the original demand curve, the equation for the new, decreased demand curve (assumed to be parallel to the original one) can be constructed as follows:

$Q^{D\_imp} = \alpha^{D\_imp} - \beta^{D\_imp}\ P^{R\_imp}$ (original demand curve 1.1) ,

$$Q^{D\_imp\_k} = \alpha^{D\_imp\_k} - \beta^{D\_imp\_k}\ P^{R\_imp}\ , \qquad 1.19$$

where

$\beta^{D\_imp\_k} = \beta^{D\_imp}$ (slopes of the two lines are the same) . 1.20

The intercept of the shifted demand curve can be estimated by substitution of the new equilibrium price and quantity:

$$\alpha^{D\_imp\_k} = Q^{D\_imp\_k} - \beta^{D\_imp\_k}\ (1-(k/100))P_{FT}\ . \qquad 1.21$$

In terms of the trade relationship, a new exporter price should emerge as the internal price in the importing country falls due to decreased demand, and this will affect the welfare of the exporter. The new wholesale price in the exporting country is again derived by using the constant margin (M_1) between the price in the importing country $(1-(k/100))P_{FT}$, such that:

$$P^{W\_exp} = (1-(k/100))P_{FT} - M_1\ . \qquad 1.22$$

(Equation 1.22 shows the wholesale price in the exporting country when price falls by k% from the free trade due to the demand response of concerned consumers in the importing country).

The change in farmers' welfare can be estimated using the price at the farm level using the constant relation defined earlier such that

$$P^{F\_imp} = (1-(k/100))\, P_{FT} - M_2 \quad . \qquad 1.23$$

(Equation 1.23 shows the farmers' price at the importing country when price falls by k% from the free trade, due to concerned consumer response.)

Next, the welfare measures are constructed.

$PS_{FT}^{imp\_k} = \int_0^{Q_{FT}^{S\_imp\_k}} \left[((1 - k/100)P_{FT} - M_2) - P^{F\_imp}(Q^{F\_imp})\right] dQ$ is the farmers' economic surplus under free trade when heterogeneous consumer response decreases price by k%.

$CS_{FT}^{imp\_k} = \int_0^{Q_{FT}^{S\_imp\_k}} \left[P^{R\_imp}(Q^{D\_imp}) - (1 - k/100)P_{FT}\right] dQ$ is consumer's economic surplus under the free trade regime.

The economic welfare for exporters is

$$PS_{FT}^{exp\_k} = \int_0^{Q_{FT}^{S\_exp\_k}} \left[((1 - k/100)P_{FT} - M_1) - P^{W\_exp}(Q^{S\_exp\_k})\right] dQ \; .$$

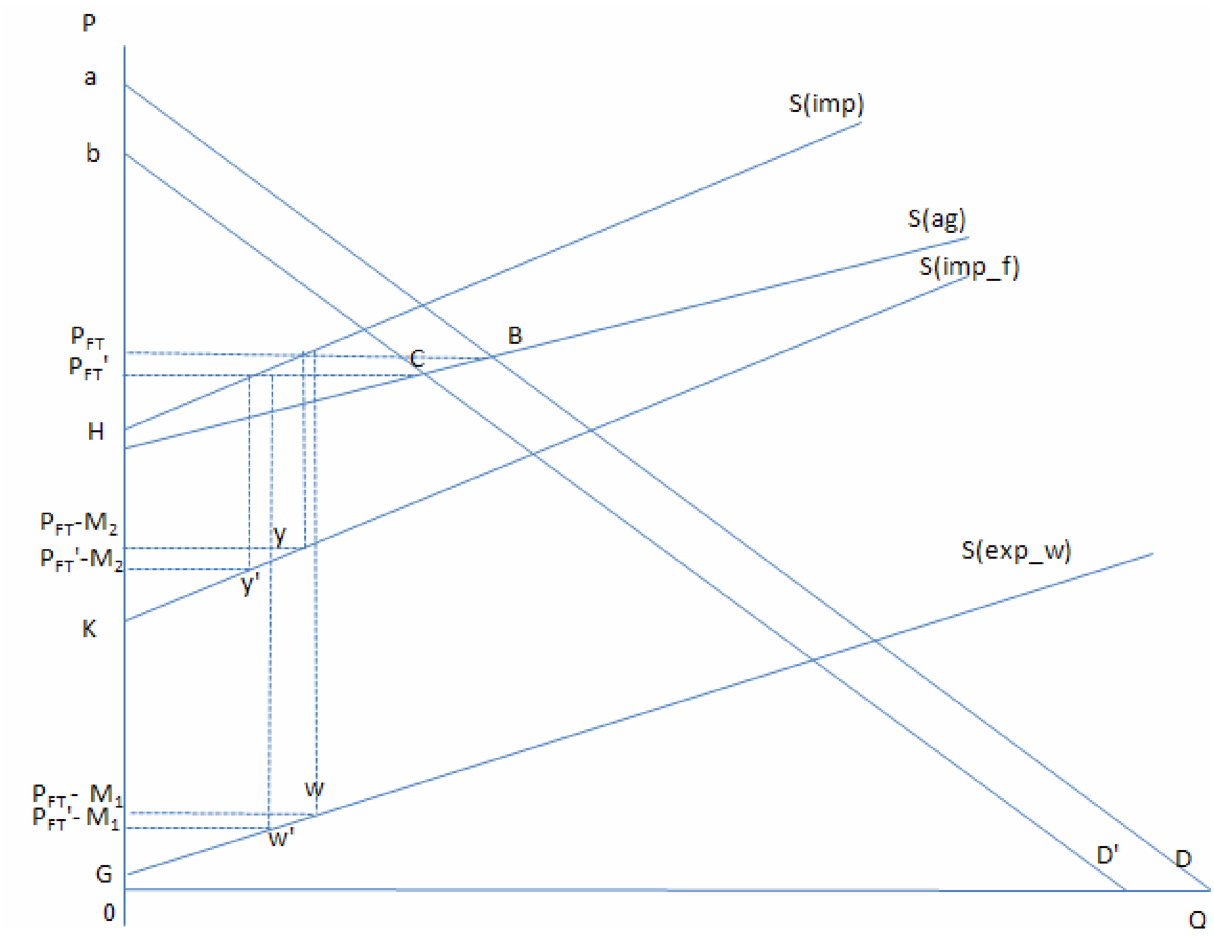

Figure 1.3 k% price decrease from the free trade level

In Figure 1.3, D' represents the new, shifted demand curve after equilibrium price in the market falls by k% from its free trade level. P_{FT}', P_{FT}'-M_2, and P_{FT}'-M_1 are the equilibrium prices at the retail and farm level in the importing country; and at the wholesale level in the exporting country, respectively. Ky'(P_{FT}'-M_2) is the decreased producer surplus, P_{FT}'Cb is the decreased consumer surplus, and Gw(P_{FT}'-M_1) is the new, decreased wholesaler surplus in the exporting country if the equilibrium price falls by k% from its free trade equilibrium due to consumer response. Welfares of all agents decrease if heterogeneous preference structure in the importing country push free trade price down by k%.

The MIP scheme applied by the importer will not be relevant if the fall in demand is not sufficient to cause the import price to fall sufficiently. However, if the price falls below the MIP, then the fall in demand will have an additional effect on the exporter. In that case it is assumed that the exporter will attempt to supply exactly at the MIP, since going below that price will be more harmful.

We can reflect this by assuming an upward shift in the export supply curve, reducing the exports supplied. This will trigger a shift in the aggregate supply curve in the importing country, resulting in an increase in the domestic price, compared to the absence of the MIP. The actual price increase in the retail market of the importer depends on the share of exports in aggregate supply. This increase in internal price will decrease quantity demanded and the demand for exports, possibly decreasing the profits for exporter. A practical example where the MIP is applied to Turkish tomato exports by the EU will be presented in the coming sections using altered demand and supply functions.

1.2.3. Concerned consumer loss: n% decrease in the equilibrium quantity demanded

In the second analysis of the effects of heterogeneous preferences on welfare under free trade, it is assumed that concerned consumers stop consuming the product altogether. Total demand decreases until it reaches n% of its original. For the sake of simplicity, assuming a given per capita consumption of the product in the base case and that concerned consumers represent n% of the population consuming the product will be helpful. The new, shifted demand will equal to (1-n/100) of the original free trade amount. Modification of the functions to estimate the welfare effects is very similar to the price decrease case above. The new aggregate supply quantity after the shift is equal to (1-n) % of the free trade supply amount with consumers having homogeneous preferences is derived.

$$Q_{FT}^{Ag\_n} = (1-n/100)Q_{FT}^{Ag} \quad . \qquad 1.24$$

Let the equilibrium price on the aggregate supply curve at this new quantity be P_{FT}^{n} which is also on the new demand curve as this represents the new equilibrium price. In other words, $(1-n/100)Q_{FT}^{Ag}$ and P_{FT}^{n} are the new price-quantity coordinate on the new, shifted demand curve after concerned consumers have left the market. Assuming the new demand curve in this case is parallel to the original one under free trade with consumer homogeneity, the new demand curve is:

$$Q^{D\_imp\_n} = \alpha^{D\_imp\_n} - \beta^{D\_imp\_n} P^{R\_imp} ,$$

$$\beta^{D\_imp\_n} = \beta^{D\_imp} \qquad \text{(slopes of the two lines are the same)} ,$$

$$\alpha^{D\_imp\_n} = Q^{D\_imp\_n} - \beta^{D\_imp\_n} P_{FT}^{n} . \qquad 1.25$$

With new demand function and price relations defined as before, parallel welfare estimations can be derived:

$PS_{FT}^{imp\_n} = \int_0^{Q_{FT}^{S\_imp\_n}} \left[(P_{FT}^{n} - M_2) - P^{F\_imp}(Q^{F\_imp})\right] dQ$ is the farmers' economic surplus under free trade regime n% of the total population of consumers withdraw from the market.

$CS_{FT}^{imp\_n} = \int_0^{Q_{FT}^{S\_imp\_n}} \left[P^{R\_imp}(Q^{D\_imp\_n}) - P_{FT}^{n}\right] dQ$ is consumers' welfare under free trade.

The surplus for exporters is:

$$PS_{FT}^{exp\_n} = \int_0^{Q_{FT}^{S\_exp\_n}} \left[(P_{FT}^{n} - M_1) - P^{W\_exp}(Q^{S\_exp\_n})\right] dQ .$$

Depending on the ratio of concerned consumers to total consumers, the decrease in price might be larger than in the previous case where concerned consumers do not leave the market entirely but are only prepared to consume the product if its price falls. This might cause a strong violation of the MIP by the exporter, as the exporter's price decrease will also be larger. The welfare effects of MIP enforcement are again described in the case study for Turkey later in this essay.

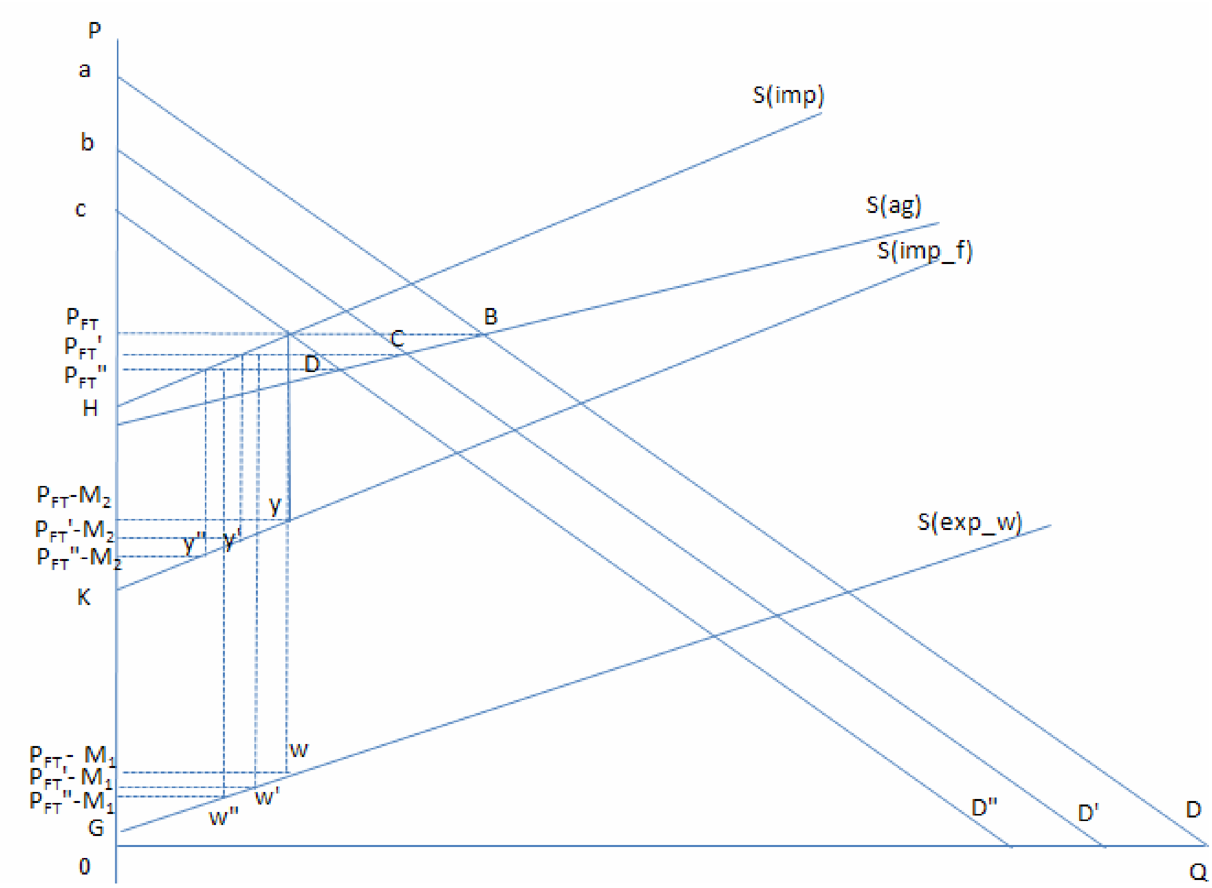

Figure 1.4 n% decrease in demand from free trade level

In Figure 1.4, D'' is the new demand curve after n% of the total consumers leave the market. Gw''(P_{FT}''M_1) is the new economic surplus for the exporter, note that it is less than that under the k% decrease in price model, because in the figure, the n% decrease in demand causes the free trade price to fall more than the k% decrease in price (i.e., $P_{FT} > P_{FT}' > P_{FT}''$). P_{FT}''-M_2 is the price that farmers receive as the market price falls from P_{FT}' to P_{FT}''. Farmers' economic surplus is equal to the area Ky''(P_{FT}''- M_2) in the figure. Consumer surplus is measured by the area P_{FT}''Dc. Figure 1.5 below shows changes in the curves if the MIP is enforced in this case. n% decrease in the demand decreases exporters' price such that it drops down to a level less than the minimum entry price set by authorities in the importing country. Importing country lets exports only at MIP or over MIP, since it is not profitable to sell at a price higher than MIP, it is assumed that all exports will be supplied at MIP in this case. These changes are expressed in the form of an upward shift in the export supply curve from S(exp_w) to

S(exp_w)_MEP, which in turn results in an upward shift in the aggregate supply from S(ag) to S(ag)_MEP. Market price in the importing country increases from P_{FT}” to P_{MEP}, decreasing the quantity demanded. These changes increase the producer welfare in the importing country and decrease the wholesaler welfare in the exporting country. Producer welfare increases from Ky”(P_{FT}”-M_2) to Ky_MEP(P_{MEP}-M_2), and consumer welfare in the decreases from P_{FT}”Dc to P_{MEP}Jc.

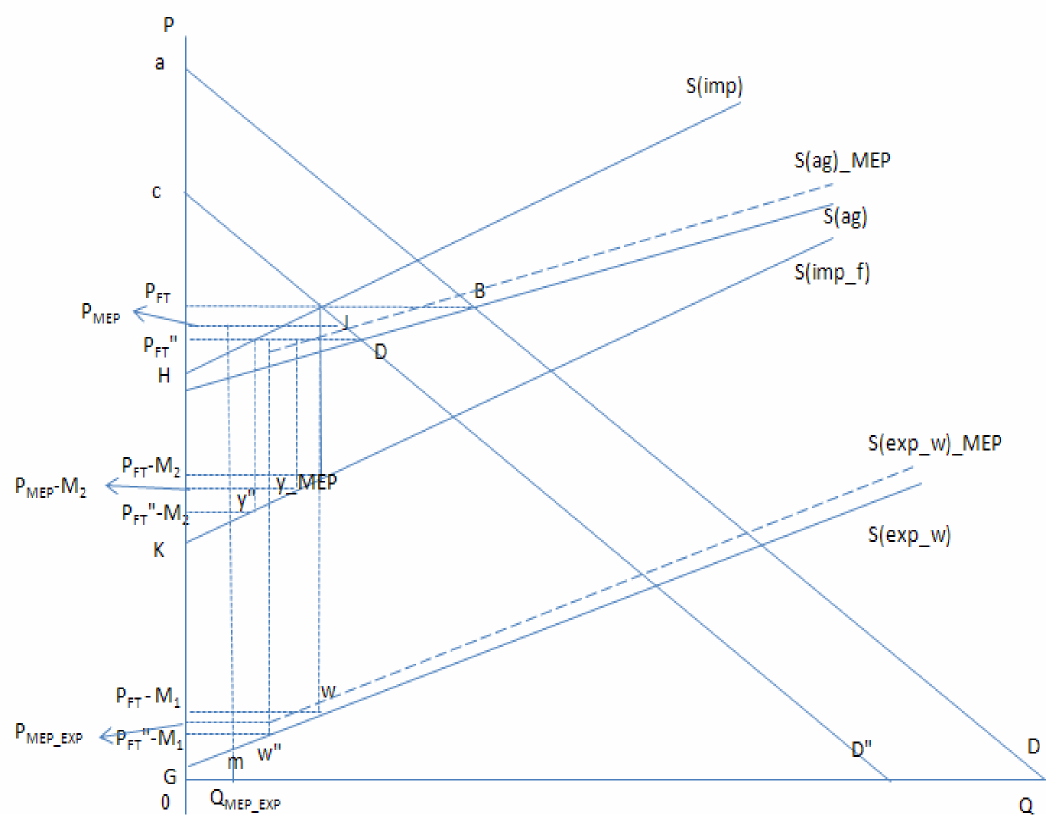

Figure 1.5 n% decrease in demand and a minimum import price (MIP)

1.2.4 Welfare effects of mandatory labeling

The previous cases represent situations in which consumers cannot distinguish higher and lower qualities of the product as this information is not transmitted from producers to consumers. Now, it is assumed that the importing country requires mandatory labeling of country of origin (COOL) on imported products.

The label enforcement allows the concerned consumers to distinguish imported products (which they perceive to be of lower quality and therefore of lower value) and the domestically produced ones (which they perceive to be of higher quality and of higher value, and are therefore may be willing to pay more for these). COOL gives rise to a differentiated market as there are also consumers who may not consider there to be a difference between domestic and foreign products and will only care about the lowest price: we shall refer to these as indifferent or unconcerned consumers.

Under the labeling scenario, there will be a higher priced market consisting of product of domestic origin and a lower priced one consisting of imported products, for concerned and unconcerned consumers, respectively. However, there should be sufficient export supply to cover unconcerned demand. If unconcerned consumers demand more than the foreign products entering their country, they also demand some of the domestically supplied items, if offered at a lower price. In other words, if there are not enough exports to cover unconcerned consumers' demand, unconcerned consumers will also consume some of the domestic produce.

Let Q_C and Q_U, P_C and P_U be the quantity of consumption and the price for concerned and unconcerned consumers, respectively. Again, Q^{S_imp} and Q^{S_exp} are used for domestic supply and for export supply to the importing country. Dealing with the case where there are not enough exports to cover all the unconcerned consumer demand, domestic producers will supply for both concerned and unconcerned consumers at a higher price than free trade. Thus, the equilibrium price for domestic products on the market will be a weighted average, the weights depending on the share of domestically supplied products sold to concerned and unconcerned consumers; this in turn depends on the supply of imports such that:

$$P^W = P_C \frac{Q_C}{Q_C + Q_U} + P_U \frac{Q_U}{Q_C + Q_U} \quad . \qquad 1.26$$

The market clearing condition is the same as under free trade except that there are two separate prices and two separate demand functions instead of one aggregate demand function:

$$Q^{S\_imp} + Q^{S\_exp} = Q_C + Q_U \ . \quad 1.27$$

Using the relationships between prices already defined, the market clearing equation can be written in terms of one price (say, P_U) and solved for that price. The relationship between this price and all other prices in the system (say, P_C, P_W) can then be used to determine those prices. However demand needs to be partitioned into Q_C, Q_U (i.e., functions for unconcerned consumer demand and concerned demand should be specified) to be able to use the market clearing identity.

Now, letting concerned consumers be n% of the total consumers of the product under analysis and assuming that the n% are willing to pay r% more than the unconcerned consumers under free trade, the new demand functions can be specified as follows using the parameters of the original demand curve before partition:

$Q^{D\_imp} = \alpha^{D\_imp} - \beta^{D\_imp} P^{R\_imp}$ (original demand curve) ,

If $Q_C = = \alpha_C - \beta_C P_C$ (concerned consumers' demand curve) ,

then, $\alpha_C = (n/100)\ \alpha^{D\_imp}$, and

$$\beta_C = \beta^{D\_imp} \left((n/100) / (1+r/100) \right) \ . \quad 1.28$$

If $Q_U = \alpha_U - \beta_U P_U$ (unconcerned consumers' demand curve) ,

then, $\alpha_U = (1- n/100)\ \alpha^{D\_imp}$, and

$$\beta_U = \beta^{D\_imp} (1-(n/100)) \ . \quad 1.29$$

It is possible to write every single demand and supply equation under the market clearing condition ($Q^{S\_imp} + Q^{S\_exp} = Q_C + Q_U$) in terms of one variable. Every equation is expressed in terms of the unconcerned price (P_U) of the market and the second order quadratic equation is then solved for P_U. Substituting in margin differences, other prices and quantities can then be derived for the welfare analysis under the mandatory labeling policy.

$CS_U = \int_0^{Q_U} \left[P_U(Q_U) - P_U^*\right] dQ$ is the economic surplus of unconcerned consumers if the market clearing price is P_U^*;

$CS_C = \int_0^{Q_c} \left[P_C(Q_C) - P_C^*\right] dQ$ is the economic surplus of concerned consumers;

$PS_L^{exp} = \int_0^{Q_L^{exp}} \left[(P^W - M_1) - P^{WS\_exp}(Q^{S\_exp})\right] dQ$ is the economic surplus of the exporter when P_W is the market price for domestic production; and

$PS_L^{imp} = \int_0^{Q_L^{S\_imp}} \left[(P^W - M_2) - P^{F\_imp}(Q^{F\_imp})\right] dQ$ is the economic surplus of farmers in the importer country under the labeling regime.

1.3 Case study: Turkish tomato exports to the EU: background

1.3.1 Tomato industry in Turkey

Turkey's climate and geography allow the growth of different types of fruits and vegetables in high quantities. Exports of fresh fruit and vegetables, therefore, is one of the leading sources of income for farmers in Turkey. Tomatoes are one of the most important fresh products (approximately 38% of total vegetable production) produced and sold by Turkey both in domestic and international markets. Total fresh tomato production in Turkey was 7.2 million tons in 2009 (total quantity was 10.7 million tons including tomatoes for processing) (Turkish Statistical Institute 2010). These numbers put Turkey in the third position among the tomato producing nations in the world (UN FAO 2010). The Mediterranean region (especially, the province of Antalya) is the leading region in tomato production with 17% of total quantity of tomatoes produced in Turkey. Tomato production both takes place in open fields and in greenhouses. Production for fresh consumption is mainly sold on spot markets (without contracts between farmers and traders) while tomato production for processing is largely based on contracts.

Table 1.2 Production quantities and their decomposition into domestic and foreign markets for 2007-2009 for fresh tomatoes grown in Turkey

	Years		
	2007	2008	2009
Production (thousand tons)	6,972	7,420	7,200
Domestic consumption (thousand tons)	6,600	6,980	6,768
Exports (thousand tons)	372	820	432

Sources: Cakiroglu 2009 and Turkish Statistical Institute 2010

On average, 96% of the fresh tomato production is sold on the domestic market and the remaining quantity is exported. Table 1.2 shows production quantities for fresh tomatoes and the consumption rates in domestic and foreign markets between 2007 and 2009.

Although a minor portion of the total quantity is exported, it generates a substantial amount of profit for exporters. Russia, followed by the EU, is the leading importer for fresh tomatoes from Turkey.

Although demand for tomatoes is strong in international markets, quality and price are the determining factors for export capacity. Turkish tomato producers are not in a position to export their products personally. They need to collaborate with an export company. On the other hand, there is no “guaranteed amount of sales” for the producer. Therefore, there is a risk of overproduction and/or low-profit sales depending on the season and economic conditions in international markets. For instance, in May 2009 the price for fresh tomatoes reached $3.20 per kilogram but because of a rapid increase in temperature, farmers in Turkey and Russia had to harvest earlier than usual. This caused a drastic decrease in prices with a reduction to $0.60-$0.80 per kilogram by the end of month, which was claimed to be far below production costs (FreshPlaza 2009). There is also considerable competition between Turkey and other countries such as Spain and Morocco which try to increase their share in the same markets.

Given the aforementioned reasons, and considering the different nature of the tomato processing industry (contractual, riskless relationship between farmers and processors) one should divide fresh tomatoes into two sub-groups: Those being supplied to the domestic market and those being exported. As shown in Table 1.2, exported fresh tomatoes occupy not more than 6% of the total amount.

Turkey's fresh tomato export values (in thousand US dollars) for 2000-2009 are presented in Figure 1.6. This shows that these values increased constantly.

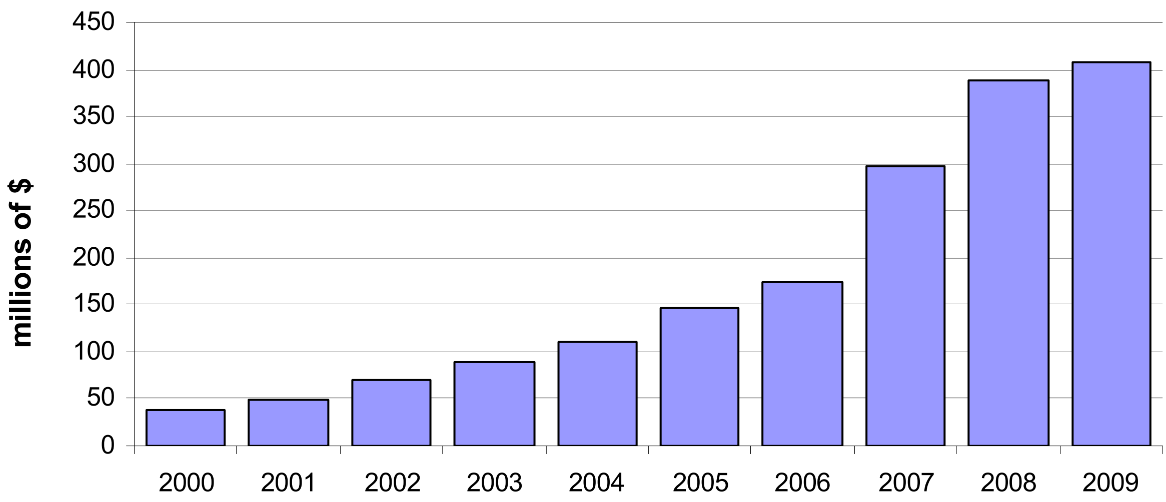

Figure 1.6 Turkey's fresh tomato exports, 2000-2009
Source: UN ComTrade 2010.

Having said about the situation in Turkey, a description of the EU export regime on tomatoes will be provided in the next section.

1.3.2 EU export regime for tomatoes

Although their population increasingly demands different varieties of fresh produce given their increasing per-capita income, the majority of the EU members are restricted seasonally in fresh fruit and vegetable production. As a result, the EU is currently the largest fruit and vegetable importer in the world ($19.213 billion in 2008, intra-EU trade excluded, see Figure 1.7). Turkey is the main non-EU trade partner in this commodity group (UN ComTrade 2010).

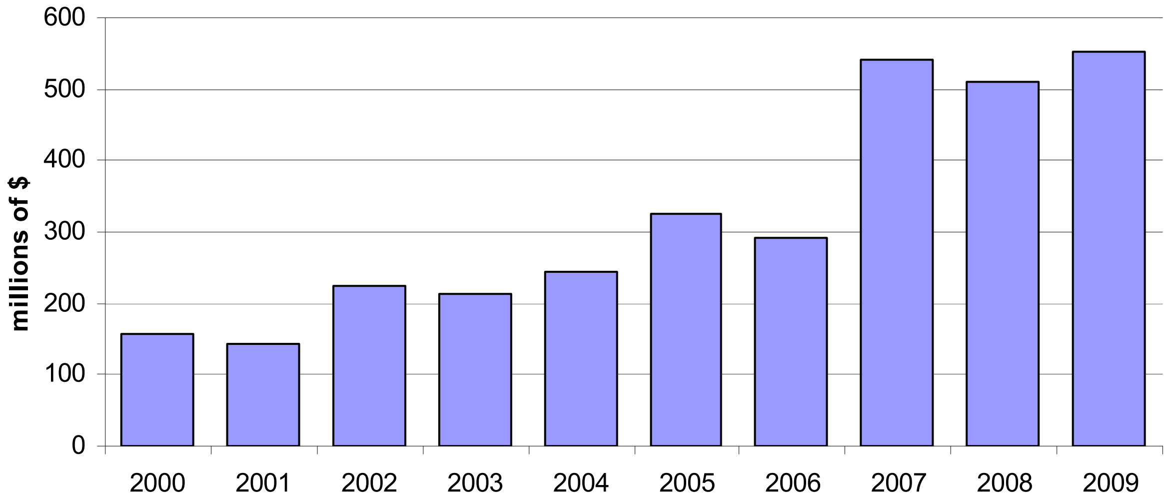

Figure 1.7 Fresh tomato imports of the EU countries, 2000-2009
Source: UN ComTrade 2010.

EU imports in the fresh produce group are very diverse, but in terms of value bananas, grapes, apples, oranges and hazelnuts among fresh fruit (and nuts); and tomatoes, beans, peppers and potatoes among fresh vegetables lead the list. In 2009, 2008 and 2007, fresh tomatoes were the leading category among all EU fresh vegetable imports.

The EU grants different levels of access for fresh produce to exporting countries through preferential agreements, and this has resulted in the current structure of export supplies to the EU (see Kurzweil, Ledebur, and Salamon 2003 for details). For example, a preferential agreement between Morocco and EU has been in place since March 2000, which created an important advantage for Moroccan tomato exporters. Morocco is the only country in the world that can export its tomatoes under a preferential entry price to the EU (Chemnitz and Grethe 2005).

A close investigation of the entry price system of the EU is essential for a complete review of the EU trade regime for fresh produce. This system covers some of the fruit and vegetable products considered as sensitive by the EU. In summary, for any import whose c.i.f price is above the entry price, the regular ad valorem tariff is applied. On the other hand, when the c.i.f price is below this entry price, an additional specific duty is paid together with the ad valorem tariff and the amount of this duty increases as the gap between the entry and c.i.f prices increase. On its domestic market, the European Commission calculates a daily c.i.f. value by the country of origin which is called the standard import value (SIV) and exporters can check their compliance with this pre-calculated c.i.f value. Entry prices and tariffs change seasonally according to the needs of domestic EU producers.

There are non-tariff measures related to food quality and safety standards may also affect EU trade in fresh fruit and vegetable products. In the EU market, there is a common legislation for labeling, plant health, hygiene, genetically modified organisms (GMO) and pesticide residues. EU Member States inspect goods at their first point of entry which might be an airport, harbor or land frontier. If a product complies with the regulations, it can be freely distributed across EU member states. However, an inspector may also decide not to inspect the entering food items. If, on inspection, the produce is not in conformity with the EU standards, the consignment: 1) may be denied entry; 2) may be downgraded; 3) may be re-sorted so that a conforming part is allowed to enter the EU; or 4) may be returned or destroyed. If the product is only lacking in terms of some standards, it can be accepted for usage in the industrial sector (i.e., tomato paste production, fruit jam production, etc.) within the EU. Presences of any pests that may have entered the products during their transportation to the EU border are also viewed to represent non-compliance with the regulations and the consignment is rejected. In some infrequent pest infestation cases, a consignment may enter the EU after being sanitized but the sanitization cost is borne by the exporter. All exporters pay varying fees for regular import procedures and inspections. They also pay a fee called "phyto-sanitary fee" depending on the dimensions of the consignment or its volume, and category.

Phyto-sanitary protection in the EU is based on its "Plant Health Directive" (Council of Europe 2009). Although products subject to potential pests that should be put under quarantine and commodity-specific requirements are commonly listed for all member states, each member is allowed to introduce its national legislation implementing common EU directives with country specific details. According to the Plant Health Directive, all produce crossing the EU border must be accompanied by a phyto-sanitary certificate issued by the National Plant Protection Organization of the country in which the product was grown. These certificates can not be issued by any private organization.

Fresh fruit and vegetables are also included in EU legislation for food hygiene. This legislation requires the use of clean water (water that is free of harmful chemicals and organisms) when washing products before packing, and harvesting and packaging staff must obey hygiene rules, etc. Certification through such schemes as HACCP and GlobalGAP are generally used by exporters to assure EU members of the quality and hygiene levels of their exports. Another set of EU legislation regulating agricultural imports concerns the maximum allowed residue levels of pesticide and other chemicals that might remain on products. This special legislation (Council of Europe 2005) sets the maximum residue level (MRL) for each pesticide and each product and these are constantly updated.

On the quality side, for certain commonly imported fruit and vegetables special parameters are published by the EU to serve as a quality indicator. These concern shape, size, color, maturity and damage. Quality of other products can be determined in accordance with United Nations Economic Commission for Europe (UN-ECE), The Codex Alimentarius

Commission (CODEX)[7] or the Organisation for Economic Co-Operation and Development (OECD) standards. Recently, some of the big supermarket chains (such as Tesco in the UK and Aldi in Germany) have started to set higher requirements than any of these standards. Fresh fruit and vegetables entering the EU should also be packed in bulk in boxes or small packages for consumer use where each package is labeled. If the item contains a GMO, the EU has additional strict traceability and labeling requirements.

Although the European legislation on fresh fruit and vegetable exports is very comprehensive, products from certain countries arriving at the EU border are inspected less often as inspection organizations in these countries have been previously recognized by the EU. These countries are Egypt, India, Israel, Kenya, Morocco, Senegal, Switzerland, South Africa and Turkey.

In any aggregate or partial equilibrium analyses involving fresh fruit or vegetable exports to EU area, the specific product requirements and price regimes should be considered to make conclusions on the welfare of the agents involved.

1.3.3 Conditions in European markets for Turkish tomato exporters

Some EU members are tomato producing countries. The largest tomato producers in the EU are Italy and Spain. Greece, Portugal, France, Netherlands and Belgium are the other major tomato producers within the EU. However, harvest seasons, varieties produced and production methods vary across these EU countries which affect the competitiveness of extra-EU exporters. The degree of competition reaches its peak in December, January, February and March, and these are also the months for peak Turkish exports.

Roughly 80% to 90% of total production in Italy is for industrial purposes and the remaining fresh tomatoes harvested are mainly consumed at home. On the other hand,

[7] The Codex Alimentarius Commission, Latin for "food code", is an inter-governmental body that sets guidelines and standards to ensure 'fair trade practices' and consumer protection in relation to the global trade of food.

Spanish tomato production is export market oriented . However, as its concentration of exports is during different periods within the year, Turkey is not a direct competitor with Spain. What's more, Turkish exports are priced well above the MIP set by the EU most of its exporting season, suggesting that any competitive pressure from any other country a very low probability.

Pesticide residues are a major main concern for Turkish tomato exporters, followed by quality-related concerns. As mentioned earlier, fresh fruit and vegetables carrying certain certificates have greater acceptability at the EU border as certification is provided by independent parties and serves as an indicator of quality. GLOBALGAP, (erstwhile EurepGAP) is the mostly widely recognized standard for business-to-business trade in farm produce, mainly within the EU. GLOBALGAP is a pre-farm-gate standard, which means that the certificate covers the process of the certified product from farm inputs like feed or seedlings and all the farming activities until the product leaves the farm. GLOBALGAP includes annual inspections of producers and additional unannounced inspections. Although not legislated, exporters are aware that a key requirement for exporting to European markets is the GLOBALGAP certification because these markets are already dominated by supermarkets that require this certificate from their suppliers. Certification decreases export risk for EU markets, as products carrying these are rarely inspected at the border.

1.3.4 The Turkey-EU partial equilibrium model

In this section, the partial equilibrium model developed in the preceding sections will be applied for a representative year and a commercial product traded between two representative countries. Numerical estimates will be derived for the orders of the magnitude and quantitative implications of consumer response and its potential interaction with import policies. While the magnitude of these estimates can differ depending on the parameters and base year values adopted, the analysis still sheds light on the quantitative implications of the model developed comparing scenarios differing in import policies and consumer preferences in the importing country.

The partial equilibrium model is operationalized using base values for 2006 and the potential impacts of a range of scenarios with respect to the treatment of fresh tomatoes from Turkey both by the EU consumers and trade policy makers are illustrated.

a) EU supply

In order to quantify the welfare of different economic agents when change occurs in trade regimes, demand and supply functions for these agents need to be specified. In this essay these functions will be approximated by using assumed elasticities and base price and quantity values.

Importers in this study refer to those EU countries that have the largest tomato imports from Turkey in terms of import value. The most recent year for which data on prices, quantity demanded and quantity supplied and prices in these countries available is 2006. In 2006, the top EU importers of Turkish tomatoes were Austria, France, Germany, and the Netherlands. Base prices (an average price for countries aforementioned) and quantities (aggregate consumption and production values) are collected and an elasticity value is applied both for the specified point on the EU domestic supply and demand curves. Next, the Turkish export supply curve to these countries is estimated by applying an elasticity value to the base period Turkish tomato export-price point.

Throughout this case study**,** EU production of tomatoes in 2006 refers to the sum of production of each individual country (Austria, France, Germany, and the Netherlands). To obtain a representative price for these top importers of Turkish tomatoes, prices in each country are weighted by the level of production. The production-weighted average price is then used to derive an aggregate EU tomato price. For 2006, total EU tomato production was 1,368 thousand tons according to EUROSTAT database (European Commission 2007). Farm prices for individual countries are also collected from EUROSTAT and then weighted by individual production amounts. On this basis the weighted average EU tomato price for 2006 at the farm level is estimated at €732 per ton.

Although the availability of micro data on retailer pricing and sales is a very important asset in supply and demand function estimations, such data are not available. EU retail prices for tomatoes are not published and contacts with EUROSTAT and statistical offices in individual countries did not yield any results. However, to carry out an analysis at the consumer level (i.e., to derive the tomato demand curve for EU consumers), final prices paid by EU tomato consumers are needed. In the absence of retail price data , a relationship between published EU farm-level prices and retail-level prices was used. Previous work on the fresh produce supply chain in the EU was used to determine an approximation for retail margins and costs.

The largest retail cost element beyond the farm price for fresh produce is attributable to labor, packaging and transportation (Worth 1999). Worth (1999) also emphasizes that for fresh produce in particular, these costs are higher than many other agricultural products which is reflected in grower-retailer price margins. So, a relatively large retail/farm price ratio is expected for tomatoes. This is partly due to perishability, shrinkage, and the additional labor costs that retailing of fresh fruit and vegetables entail. Refrigeration during transportation also contributes to the costs of supplying fresh produce. Finally, Worth (1999) indicates that a portion of the retail price should reflect the retailer profits. His estimates for US markets between January 1980 and May 1999, indicate an average retail price of $0.982 and a f.o.b price of $0.301 per pound, so the ratio of retail prices to f.o.b prices (which is usually smaller than the ratio of retail prices to farmer prices by a small amount, as f.o.b prices are expected to be larger than the domestic prices at the farm level in the importing country) is 3.26, which is a large value compared to estimates for EU supply chains as explained below.

In a target market study conducted by the Central Agricultural Marketing Information Bureau (CAMIB)[8] to guide Latvian tomato exporters, the largest tomato importing companies in Latvia were interviewed in 2005, and according to respondents' answers, a price range for tomatoes was constructed both at the wholesale and retail level. For the summer-fall season, the wholesale price range was €400-€1,000 per ton; and the retail range was €500-€2,000 per ton. For the winter-spring season, the wholesale range was €1000- €2000 per ton; and retail range was €3,500- €4,000 per ton. These results suggest a retail/wholesale price ratio of 1.25-2 for the summer-fall season, and 2.0-3.5 for the winter-spring season.

The situation specific to Spain and the Netherlands is summarized in Verhaegh (1998). The following table, which shows the situation in 1998 before retailer profits suggests a wholesale-farm price ratio of roughly 1.31 in the Netherlands; in Spain this ratio is to 2.25 possibly due to low labor costs.

Table 1.3 Cost prices in Dutch guilders[9] of Spanish and Dutch tomatoes, 1998

	Netherlands	Spain
Production	1.22	0.6
Collection and Grading	0.24	0.47
Wholesalers	0.09	0.06
Transportation (to Frankfurt)	0.05	0.22
Total	1.60	1.35

Source: Verhaegh 1998.

Djelloul, Réquillart, and Simioni (2008) examined weekly final consumption and prices at both shipper and consumer levels for two types of tomatoes (grape tomatoes and round tomatoes) in France for the period between years 2000 and 2006. The retail margin in their study is calculated as the difference between the consumer and shipper prices. They

[8] The Central Agricultural Market Information Bureau (CAMIB) was created in 1997 and currently, it serves as an autonomous unit and registered as a non-governmental organization (NGO) under Moldovan law.
[9] The guilder in the Netherlands was replaced by the euro on 1 January 2002.

found that the average wholesale price for grape tomatoes was €1.26 per kg, and the average retail price was €2.21 per kg. For round tomatoes the average wholesale price was €0.84 per kg; and the average retail price was €1.74 per kg. Based on findings of Djelloul, Réquillart, and Simioni (2008) retail margins were quite similar for the two types of tomatoes in France and amount to €0.9 to €0.95 per kg on average.

A recent statement by Gérard Ricardi (October 11, 2009), the secretary general of the radical farmers' union MODEF (Mouvement pour la Défence des Exploitants Familiaux) in France might indicate the reasons for high retail-farm or retail-wholesale price spreads in France. "The supermarkets pay around 45 centimes[10]/kilo for tomatoes that cost 70 centimes/kilo to grow", Ricardi explains. There is 20 centimes/kilo to find for transport and packaging, before the same tomatoes are sold in Paris supermarkets for €2.50/kilo. "Here, the growers are earning 70 centimes/kilo; there is 20 centimes/kilo freight and packing, with 60 centimes for the distributor." But, "at a local shopping centre a bit further away, Spanish grade II tomatoes are being sold in a larger supermarket for €1.09/kilo. MODEF growers are not alone in resenting the kind of market distortion that arises from a European directive that has allowed countries such as Germany and Spain to exploit cheap foreign labor and undercut growers elsewhere in the European Union (Crossey 2009).

Bijman and de Graaf in a 2003 report on Dutch fresh fruit and vegetable market data, also employing various EU sector reports (see, for example, EU MEDFROL Project 2005, and the European Commission 2007) clearly show the margin distribution for each marketing stage for the year 1998, which follows the previous studies conducted in different markets of EU. However, this is the only research that shows the complete price/margin profile from the farmer level.

[10] In the European community *cent* is the official name for one hundredth of a euro. However, in French-speaking countries the word *centime* is the preferred term.

Table 1.4 Consumer price profile for fresh fruit and vegetables in the Netherlands, € per kilo

Farmer's cost and profit	0.58
Farmer price	**0.58**
Auction cost	0.03
Wholesale margin	0.12
Wholesale cost	0.08
Wholesale price	**0.81**
Retail cost	0.30
Retail margin	0.20
Retail price	**1.31**

Source: Bijman and de Graaf 2003.

Assuming all margin increases are proportionate to the final price increases in tomatoes between years 1998 and 2007, this study uses the data in table 1.4 to calculate margins between EU farm and retail markets.

Apart from EU prices at different marketing levels, an elasticity measure at these price points is necessary to define an EU domestic supply curve. However, the majority of the literature on supply responses to own price changes concentrates on major cereals and grains. Thus, not surprisingly, no previous "tomato" supply elasticity estimates belonging to EU countries were available when this study was undertaken. Nonetheless, estimates for similar countries and crops are reviewed below.

According to Torok and Huffman (1985), the US short-run supply elasticity for fresh fruits and vegetables is around 0.2. Later, Huffman et al. (1996) concluded that the U.S. long-run supply elasticity should be larger, at around 0.8. On the other hand, Ornelas and Shunway (1993) concluded that supply elasticities for tomatoes grown in Texas range from 0.27 to 0.92. The authors used annual state-level data for the period from 1951 to 1986 in their study. More recently, Chavas and Cox (1995) used non-parametric methods in the estimation of price elasticities of output supply functions for US. For vegetables in general, their estimate turned out to be 1.77.

There are few econometric estimates of Mexican supply responses in the literature (Mexico is one of the major tomato exporters in the world). Torok and Hoffman (1985) also estimated the short run elasticity of supply for Mexican fresh fruit and vegetable products as 0.8.

Grethe (2004) uses tomato supply elasticity estimates in a partial equilibrium model for the EU and Turkey. He uses assumed elasticities based on knowledge obtained from those familiar with the sector. According to his interviews, supply elasticities are high, at "around 1.5," or "significantly above 1 but below 2." (Grethe's elasticities were at the wholesale level). He explains that the ease of shifting area to fruit and vegetables from other crops, and fruit and vegetable farmers' higher market orientation on average than other farmers also supports these high elasticities. Alvarez-Coque, Martinez-Gomez, and Villanueva (2007) also assume a lower bound as 1 and upper bound as 2 for aggregate EU tomato supply elasticity.

Following the research of Grethe (2004), the EU tomato supply elasticity is taken as 1 (at the farm level) in this study. This is a lower elasticity value than Grethe's (2004); however, Grethe's (2004) elasticity was at the wholesale level while the one that will be used here is at the farmer level, implying around 30% wholesale-farmer margin.

b) EU demand

To derive tomato demand curves for EU consumers, the total consumption of tomatoes in 2006 for the top four Turkish tomato importers (Austria, France, Germany, and Netherlands) was computed. Consumption data are in tons and are collected from EUROSTAT on a country basis. Retail prices constructed using assumed margins with respect to farm prices (as explained before) are also used for demand function estimation.

As in the case of supply elasticity, the EU tomato demand elasticity is chosen on the basis of a review of the literature.

Existing estimates of the demand elasticity for tomatoes in the EU at a disaggregated level are limited. Estimates based on groupings of fresh produce (e.g., fresh fruits, fresh vegetables, fresh fruit and vegetables) are more common. Therefore, where elasticity estimates for the exact commodity under question (tomatoes) are found, estimates for different countries are reviewed. Estimates for tomatoes are also compared to those for other similar commodities (cucumbers, peppers, etc) in making a final assumption about the magnitude of the elasticity to be used.

Rickard, Pierre, and Becker (2009) uses panel data from a range of countries (including the United States, Germany, UK, Malaysia, Brazil, and Turkey) from 1991 to 2005 to estimate an aggregate own price elasticity of demand for tomatoes. Their estimate which is statistically significant is -0.119. Yen et al. (2004) grouped US consumers into high and low income groups using A.C. Nielsen Universal Product Code (UPC)[11] data for 1999 in their tomato demand elasticity estimates. Compensated and uncompensated estimates for the low income group are -0.86 and -0.95, respectively. For the high income group, compensated and uncompensated estimates are -0.81 and -0.88, respectively. These results suggest that consumers with lower incomes have more price-elastic demand for fresh tomatoes and that uncompensated elasticity estimates are larger than compensated ones as expected. For U.S tomato consumers, You, Epperson, and Huang (1996) found an estimate of -0.0405.

Simmons and Pomareda (1975), using data for 1972-73, found tomato demand elasticity of -0.5 for Mexico. Shalit (1984), using data for 1960-80, estimated an aggregate tomato demand elasticity of -1.68 for Israel. Gendall, Betteridge, and Bailey (1999) with respect to data for 1997, estimated elasticities that range from -1.5 and -2.0 for Japan.

[11] The UPC is a barcode type that is widely used in Canada and the United States for tracking items traded in stores.

Djelloul, Requillart, and Simioni (2008), carried out a detailed demand analysis for years 2000-2006 for France. They consider two specific types of tomatoes commonly consumed in France: round and grape tomatoes and use both a linear and semi logarithmic functional form to estimate demand parameters for each of these. With a linear functional form, the own price elasticity for round tomatoes and grape tomatoes are found to be -1.26 and -2.27, respectively. When a semi-logarithmic function is employed -1.24 and -1.78 are the estimated elasticities for round and grape tomatoes, respectively. Some other authors have not estimated demand elasticities but have used assumed values. Garcia-Alvarez-Coque and Martinez-Gomez (2009) assumed a lower bound of 0.5 and upper bound of 1.0 for EU aggregate tomato demand elasticity in their simulations of the impact of trade liberalization on EU tomato imports. Grethe (2004) used tomato demand elasticity for Turkish consumers of -1.00 in his analysis.

To sum up, recent studies involving tomato demand elasticities for European countries suggest a range of -1.00 to -2.00 on average. As the welfare estimations of this study are partial (focusing on tomato consumers and producers only) using elasticities conditional on fruit and vegetable expenditures rather than a whole budget would probably be desirable. Given that round tomatoes or similar varieties are grown and exported by Turkey, an elasticity measure for round tomatoes is more meaningful. Combining all these details, Djelloul, Requillart, and Simioni's (2008) estimate of conditional round tomato demand elasticity among French consumers, -1.24 is used as an approximation to the aggregate tomato demand elasticity for the EU.

c) Turkish export supply to the EU

In order to complete the analysis of the tomato market involving the EU and Turkey, a Turkish export supply curve needs to be derived. At the time this study was prepared, no measure of elasticity of tomato export supply elasticity from Turkey was available to our knowledge. Thus, elasticity is specified in accordance with domestic tomato supply and demand elasticities in Turkey following standard theoretical considerations:

In theory, a country's export supply elasticity can be calculated if its supply and demand elasticities for the same product, quantity of exports with respect to total production and demand are known:

Supply : $Q_S = \alpha_0 + \alpha_1 P$,

Demand $Q_d = \beta_0 - \beta_1 P$. 1.30

Thus excess supply/Excess demand is written as

$$Q_t = Q_S - Q_d = \alpha_0 + \alpha_1 P - \beta_0 + \beta_1 P = (\alpha_0 - \beta_0) + (\alpha_1 + \beta_1)P \quad . \qquad 1.31$$

where Q_t positive yields exports and excess supply and Q_t negative yields imports and import demand.

Derivation of elasticity of excess demand and supply elasticity follows.

domestic supply elasticity: $e_s = \frac{\partial Q_S}{\partial P}\frac{P}{Q} = \alpha_1 \frac{P}{Q_S}$,

domestic demand elasticity: $e_d = \frac{\partial Q_d}{\partial P}\frac{P}{Q} = -\beta_1 \frac{P}{Q_d}$,

elasticity of the curve ES/ED: $e_E = \frac{\partial Q_t}{\partial P}\frac{P}{Q_t}$, 1.32

Note that e_s is defined as positive and e_d as negative here.

$$e_E = \frac{\partial Q_t}{\partial P}\frac{P}{Q_t} = (\alpha_1 + \beta_1)\frac{P}{Q_t} = \alpha_1 \frac{P}{Q_t} + \beta_1 \frac{P}{Q_t} = \alpha_1 \frac{P}{Q_S}\frac{Q_S}{Q_t} + \beta_1 \frac{P}{Q_d}\frac{Q_d}{Q_t} \quad ,$$

$$\Rightarrow \quad e_E = e_S \frac{Q_S}{Q_t} - e_d \frac{Q_d}{Q_t} \quad . \qquad 1.33$$

Thus the absolute price elasticity value of ES/ED is a weighted sum of the domestic supply and demand elasticities, the weights being the ratios of domestic supply and domestic demand to the volume exported. However, this methodology assumes that the product offered in the domestic market is the same as the one being sent to the export market. There is strong evidence that tomatoes offered to the export market, and in particular for export to the EU, are of higher quality in the Turkish case, so this formulation can not be employed. That is to say, tomato markets can be differentiated according to the quality standards of the produce. Recently, tomatoes that qualify for export markets have started to be offered in major Turkish supermarkets to quality conscious, high income urban shoppers, creating another marketing channel for produce intended for export. An increase in the number of available markets for top quality tomatoes produced in Turkey can be thought to increase the elasticity of supply to any one of these markets for producers/exporters. Quantity of tomatoes actually exported can be substituted for Q_t, total quantity produced following high export market standards for Q_S, and high quality produce offered in domestic markets substitute for Q_d. Unfortunately, it is not possible to collect information on the proportion of high quality tomatoes serving major retail outlets in Turkey, therefore the approach cannot be modified

Following the earlier argument with respect to EU domestic tomato supply elasticity, Turkish export supply elasticity is also assumed to be equal to 0.91 at the wholesale level.

Data on tomato exports from Turkey to the EU and the EU's imports from Turkey can be downloaded from United Nations Commodity Trade Statistics (UN ComTrade) database. ComTrade is the registered name of the database maintained by the United Nations (UN) Statistical Office. This is one of the most comprehensive and complete databases in terms of commodity and country coverage (Gehlhar et al.1997). When Turkey's reported exports are compared with partners' reported imports, some discrepancies are observed, which is not unusual in international trade data. In an overwhelming majority of cases, when two trading partners report the value and quantity of their trade to the UN, the export figures and the corresponding import figures do not match (Gehlhar et al. 1997). There are researchers who claim that using reported exports as trade volume measures is more accurate. Some suggest that export data is free of loss of product during transportation, free of insurance and transportation charges if considered in terms of value. Some argue the reverse: reported imports should be used as the trade volume because countries tend to underreport their exports. This might due to intention to avoid taxes or to hide the real value of export subsidies. Or it might simply be the case that customs officials are less diligent in collecting data on exports than on imports. Finally, differences in recorded exports and imports can arise because product that is initially destined for a particular export market can be redirected to another market during transit – perhaps because of changes in market conditions. Following aforementioned arguments, this study does not attempt to derive a reconciliation of statistics reported and uses EU's reports of imports for 2006 as taken from ComTrade.

As mentioned earlier in the text, there is a quality gap between Turkish tomatoes produced for the domestic market and those for export. Despite this, it can be assumed that any change in tomato prices at the retail level in EU domestic markets will be reflected sooner or later in the prices received by Turkish farmers who produce high quality tomatoes, Data on Turkish prices of high quality tomatoes are only available at the wholesale level. These prices, together with the assumed elasticity and exported quantity are used to construct an export supply curve for Turkish exporters by linear approximation. Based on interviews with major tomato exporter companies to the EU, it is assumed that EU retail prices are 48% higher than the prices at the wholesale market in Turkey for all export volumes. This relationship between Turkish wholesale prices and EU retail prices is used to incorporate tomatoes coming from Turkey into the EU market.

1.3.5 European consumers' willingness to pay for Turkish tomatoes

In this study, a WTP estimate for country of origin labeling of tomatoes among EU consumers is needed to segment the EU market among imports of tomatoes from Turkey and those domestically produced. In other words, to decompose the EU aggregate demand curve among concerned EU consumers and those who are indifferent, an estimate of how the representative EU consumer differs in willingness to pay for domestically grown over imported tomatoes is needed. To make this decomposition, earlier studies of relevance have been examined.

The majority of the previous research on willingness to pay for safety and/or quality in Europe has been undertaken for meat and dairy products. Studies involving fresh produce and tomatoes are rare or focus on non-European markets.

Roosen et al. (1998) estimated the US consumers' willingness to pay for the elimination of one insecticide at a time (or insecticides as a group) combined with some appearance improvement in Washington red delicious apples. The authors conducted an experimental session in a Midwestern US university town in 1996, using second price Vickrey auction method[12] to evaluate changes in willingness to pay. They tried restricting the usage of only one insecticide belonging to neuroactive-insecticides (NAI) group, azinphos-methyl (APM), or abolishing all the insecticide in NAI group, without or in combination with the improvement in aesthetic appearance. A change to No-APM together with No-damage increased the WTP for the product by 8.8%. A change to No-APM alone increased WTP by 3.2%. Banning insecticide applications of the entire NAI group increased WTP by 8.8%. If NAI application was forbidden but apples were still damaged, the authors estimated increase in WTP of 5.6%. These results indicate that consumers value a restriction in the use of insecticides, without paying special attention to their nature.

Goldberg and Roosen (2005) examined WTP for reducing risk of contamination by the bacteria Salmonellosis and Campylobacteriosis in fresh chicken. Their study was based on German consumers in a town of 240,000 inhabitants during September and October 2004. The authors employed both a choice experiment and contingent valuation study, comparing the results to derive more robust estimates. Reductions in Salmonellosis and

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[12] A Vickrey auction is a type of sealed-bid auction, where bidders submit written bids without knowing the bid of the other people in the auction. The highest bidder wins, but the price paid is the second-highest bid. The auction was created by William Vickrey. This type of auction is strategically similar to an English auction, and gives bidders an incentive to bid their true value.

Campylobacteriosis of 0% (base level), 40% and 80% and various combinations were considered (e.g, WTP for 40% reduction in Salmonellosis coupled with 80% reduction Campylobacteriosis). The willingness to pay ranges from 12.9% (WTP for 0% reduction in Salmonellosis and 40% reduction in Campylobacteriosis) to 33.4% (WTP for 40% reduction in Salmonellosis and 80% reduction in Campylobacteriosis) under the contingent valuation method. However, the WTP for an 80% reduction in both Salmonellosis and Campylobacteriosis is only at 23.7%. The authors suggested that that the relationship between health risk reduction and WTP is non-linear and that marginal willingness to pay decreases. The authors also found that maximum likelihood estimate of the choice experiment differ significantly from the contingent valuation results for the same reduction levels. The WTP in the choice experiment study ranges from -1.6%, (for a 40% risk reduction for Campylobacteriosis only), to 66.6% (risk reduction of 80% in both Salmonellosis and Campylobacteriosis). The authors concluded that their results cannot provide an answer to which method provides the most accurate valuations.

Rozan, Stenger, and Willinger (2004) studied the impact of new information about food safety on subjects' willingness to pay for selected food products in an experimental setting. They used both Vicrey's second price auction and Becker-DeGroot-Marschak[13] (BDM) procedure to select their measures. They asked their subjects to bid before any information was provided and rebid when information was provided about health impacts of their consumption and certified and non certified products were introduced. The experiment was conducted in France in 2004 using apples, potatoes, and baguette. Under the BDM

[13] The Becker–DeGroot–Marschak method (BDM), named after Gordon M. Becker, Morris H. DeGroot and Jacob Marschak is an incentive-compatible procedure used to measure willingness to pay. The subject formulates a bid and the bid is then compared to a price determined by a random number generator. If the subject's bid is greater than the price, he or she pays the price and receives the item being auctioned. If the subject's bid is lower than the price, he or she pays nothing and receives nothing.

procedure, the price that subjects are willing to pay for apples before any information is 7.69 French Francs (FFs) per kilo. After information is provided; the price for non-certified produce drops to 3.38 FFs and that for certified produce increases to 9.55 FFs. Under the Vickrey procedure, the price for non-certified produce decreases from 4.37 to 3.31 FFs. For certified apples, the price increases to 5.68 FFs from the original price of 4.37 FFs.

Weaver, Evans, and Luloff (1992), conducted personal interviews in produce sections of grocery stores of a college town, State College, PA of US in 1990 to estimate these consumers' WTP for reduction in pesticide use in fresh tomatoes. According to their results, the average WTP for such a decrease is equivalent to a price premium of 6.57%.

Stenger (2000) also used contingent valuation methods to estimate a reduction in the use of sewage sludge in the production of fresh fruit, vegetables and cereals in France. She derived two sets of results: a WTP of 14.7% if information about real health risks is provided to consumers, and 18.9%, WTP if no information is provided and consumers answer according to their perceptions of risk. She found that willingness to pay has very similar distribution across consumers in both cases.

Bagnara (1996) evaluated the WTP for peaches that are certified as being produced under Integrated Pest Management[14] (IPM) techniques by applying contingent valuation to a group of Italian consumers in 1996. The average WTP was found to be 16.45% percent more than uncertified peaches. Consumer responses also indicated that produce not grown using IPM techniques are valued less: 54.6 of the interviewees indicated that it was worth 30% to 40% less.

Akgungor, Miran, and Abay (1999) estimated WTP for the abolition of pesticide use for fresh tomatoes among consumers in Turkey: They conducted surveys in Istanbul, Izmir,

[14] Integrated Pest Management (IPM) programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

and Ankara (the biggest 3 cities of Turkey) and concluded that consumers would be willing to pay a price premium of 2% for such tomatoes.

Latvala and Kola (2004) asked consumers in Finland about their WTP for beef products with additional safety information on labels. The average WTP estimate is 13.33% of the normal beef products consumed at the time of the study.

Arnoult , Lobb, and Tiffin (2007) used a UK-wide survey to find out the WTP for local lamb and strawberries (over their imported alternatives) in 2005.The WTP is found to be 19.5% more for domestic lamb and 32.3% more for domestic fresh strawberries. When the correspondents were asked about their WTP for labeling for the same products, the answer is 14.6% for strawberries and 11.5% for lamb meat on average.

Boccaletti and Nardella (2000) found that the WTP for pesticide free fruit and vegetables in Northern Italy in January 1998 was 8.77% on average.

Baker (1999) presents a good summary of research using contingent valuation estimates for WTP. He emphasizes that contingent valuation studies have shown a wide range in consumers' willingness to pay for food safety attributes.

These studies suggest that willingness to pay for food safety attributes in fresh produce is more than other food products although it depends on many other factors. Based on the previous estimates and expert opinions, in this study we assume that concerned consumers in European countries will pay 15% more for domestically produced tomatoes than imported ones, if they are able differentiate these two. This difference might be due to health concerned consumers' perception on differences in pesticides used, production technology employed and other differences between domestic and imported fresh tomatoes. However, to be able to use that information, the percentage of European consumers who are concerned should also be known. If we assume that fair trading is positively related to quality of fresh produce, results of a European Commission's Directorate General for Agriculture's survey on attitudes of European consumers to fair trade bananas might give a very rough idea

(European Commission 1997). This survey indicates that one third of the EU consumers are willing to pay more for fair trade bananas, possibly because they perceive that they will reduce risks to society in this way. However, fair trade concept values public and environmental risks more than that to the individual consuming the produce. One of the Eurobarometer surveys whose results also based on public interviews offers a more precise measure of this. The survey suggest that “amongst who recall having seen or heard media reports on unsafe and unhealthy food, the majority states that as a result, they have either permanently changed their eating habits (16%) or temporarily avoided the food mentioned for a while (37%).” (European Commission 2006, page 6). The research emphasizes that the extent to which people are concerned about food safety is related to the way in which they react to media coverage of food-related problems (European Commission 2006). The fact that over 40% of the consumers either ignore stories in the media or choose to do nothing in response to these implies that they are “unconcerned”. Based on this evidence, it is assumed that 51% (37% + 16%) of EU consumers are concerned about food safety in this study. The degree of concern might be different among this group, however this may not make a theoretical difference in our results, thus, this detail is not considered. According to this study all concerned consumers are willing to pay more for increased perceived safety by the same amount. Misra, Huang, and Ott (1991) found that 46% of Georgia (of USA) consumers are willing to pay more for certified residue-free produce, conforming this approximation for the US case.

1.3.6 Estimates

Table 1.5 summarizes the base values used in the numerical analysis of the implications of food safety concerns for Turkish tomatoes in the EU. The analysis is based on 2006 which is the latest year for which complete comparable data on quantities and prices can be obtained.

Table 1.5 Base values of the partial equilibrium model of fresh tomato exports from Turkey to EU

Description	Values
EU supply side	
EU domestic production in 2006 (thousand tons[15])	1,413
Farm price in the EU in 2006 (Euros/ton)	790
Farm supply elasticity	1
Wholesale price in the EU in 2006 (Euros/ton)	1,106
Wholesale supply elasticity	1.4
Retail price in the EU in 2006 (Euros/ton)	1,770
Retail supply elasticity	2.24
EU demand side	
Consumption in the EU in 2006 (thousand tons)	1,421
Demand elasticity	-1.24
Share of health-concerned consumers of tomatoes in the EU in 2006 (percentage)	51%
Health concerned consumers' willingness to pay for labeling (as a percentage of the base price)	115
Exporter side	
Exports from Turkey in 2006 (thousand tons)	8.5
Wholesale price in Turkey in 2006 (Euros/ton)	717
Wholesale supply elasticity in Turkey in 2006	0.91

a) Autarky

As mentioned earlier, the autarky scheme can be considered as a non tariff barrier by the EU market (i.e., a prohibitive measure), that totally prohibits the entry of imports of fresh tomatoes from Turkey. Since there is no trade, only EU domestic supply/demand relationships constructed using the base parameters need to be considered. Using these and

[15] "ton" is used in place of "metric tons" in this essay

the relevant base data from Table 1.5, consumer and producer welfare can be computed under autarky (no welfare for exporting county producers as no market exists for these). Table 1.6 below shows the resulting demand and supply equations, price and quantity at the equilibrium and welfare estimates for EU economic agents.

Table 1.6 Autarky

	Intercept	Slope
EU supply	-1,752,028	1,788
EU demand	3,184,082	-996

Equilibrium price (Euros/ton)	1,773
Equilibrium demand (supply) (thousand tons)	1,418
Farm level supply price in the EU (Euros/ton)	793
Farmers' surplus in the EU (million Euros)	563
Consumers' surplus in the EU (million Euros)	1,010
Total surplus in the EU (million Euros)	1,573

b) Free Trade

In this section, it is assumed that Turkish fresh tomato exports can enter the EU without any restriction. A Turkish fresh tomato export supply function to the EU is introduced using the base values from table 1.5. The aggregate supply function is the sum of this Turkish export supply and the EU domestic supply function. The new supply quantity is termed the EU aggregate supply in table 1.7 below.

Table 1.7 Free trade

	Intercept	Slope
EU supply	-1,752,028	1,788
EU demand	3,184,083	-996

Turkey's export supply	-10,650	10.8
EU aggregate supply	-1,762,678	1,799

Equilibrium price (Euros/ton)	1,770
Equilibrium demand (supply) (thousand tons)	1,421.5
Exports from Turkey (thousand tons)	8.5
Farm level supply price in the EU (Euros/ton)	790
Wholesale price in Turkey (Euros/ton)	717
Farmers' surplus in the EU (million Euros)	558
Consumers' surplus in the EU (million Euros)	1,015
Total surplus in the EU (million Euros)	1,573
Wholesalers' surplus in Turkey (million Euros)	3.4

Given these estimates, it can be seen that wholesalers and producers in Turkey (wholesaler surplus in table 1.7 is defined as the sum of producers' economic surplus plus wholesalers' profits) benefit from trade liberalization (the change from full protection to free trade, in this example), as their profits were zero under autarky. EU farmers lose from free trade with Turkey. The additional tomato supplies entering the EU decrease the price prevailing in retail markets and the farm prices, if there are no changes in the demand curve, hence, EU producers are destined to lose some of the economic surplus that they realize under autarky. EU consumers gain due to the decreasing price effect from the supply increase linked to the entry of Turkish produce into the market (assuming they do not alter their demand curve).

The total effect of changing of trade regime from autarky to free trade is positive for the domestic country. This is because the decrease in price is large enough for the gain in consumer surplus to overweigh to loss in producer surplus.

c) Free trade with heterogeneous preferences among EU consumers

Up to this section, it has been assumed that all EU consumers have the same preference structure and, in particular, that they do not perceive any difference between Turkish and domestic tomatoes. In the real world, consumers might have preferences such that they perceive exported and domestic produce to be different. To examine this first, it is assumed that concerned consumers are reluctant to buy tomatoes at the free trade price mentioned earlier, thus, they leave the market until the equilibrium price falls sufficiently to induce them to purchase. Second, it is assumed that such consumers (who represent a significant fraction of the total consumers of tomatoes in EU market) reject the imported product entirely and leave the market no matter what the price level is. This is because they are unable to distinguish the imported product from the domestically produced one.

i) Concerned consumers withdraw from the market until the equilibrium price falls by 15% from its free trade level

In this section, because they can not differentiate the origin of the product, it is assumed that concerned consumers choose not to purchase tomatoes until the price falls to a level consistent with their valuation of the product in the presence of imports. Following the discussion of the literature earlier, it is assumed that the price at which they will begin to purchase again is 85% of the price prevailing under free trade with homogenous consumers (i.e. 85% of the 1,770 Euros in table 1.7). This is equivalent to a leftward shift in the total demand curve representing both unconcerned and concerned consumers in the market. The decrease in demand will affect both groups of consumers (not only concerned ones) and producers in both countries, as indicated in Table 1.8.

Table 1.8 Effects of a 15% decrease in price that concerned consumers are willing to pay

	Intercept	Slope
EU supply	-1,752,028	1,788
EU demand	2,443,424	-996
Turkey's export supply	-10,650	10.8
EU aggregate supply	1,762,678	1,799

Equilibrium price (Euros/ton)	1505
Equilibrium demand (supply) (thousand tons)	945.2
Exports from Turkey (thousand tons)	5.7
EU Farm level supply price (Euros/ton)	525
Wholesale price in Turkey (Euros/ton)	452

Farmers' surplus in the EU (million Euros)	246
Consumers' surplus in the EU (million Euros)	449
Total Surplus in the EU (million Euros)	695
Wholesalers' surplus in Turkey (million Euros)	1.5

The decrease in demand by concerned consumers due to lack of information about the origin of the produce on the market decreases the welfare of all agents compared to the free trade level with homogenous consumers. The fall in demand causes the price and quantity to decline relative to the free trade equilibrium. EU domestic supply, domestic supplier price, and the price received by exporters and their supplies fall. The resulting change in welfare depends on the relative changes in quantity and price generated by the initial decrease in demand. A decrease in the retail price of 15% is associated with a fall in the total quantity supplied from 1,421.5 thousand tons to 945.2 thousand tons, i.e., almost a 34% decrease. Since decrease in price is consistent with a relatively large decrease in quantity, welfare is expected to decrease significantly, which is the case. The change in the equilibrium quantity is determined by the elasticity of respective supply and demand curves and this determines the welfare effect for the different agents.

ii) Minimum entry price enforcement for Turkish exports when the EU internal price decreases by 15% from the free trade level

As the reaction of concerned consumers causes a decrease in the price level in the EU market, this can cause the import price for Turkish tomatoes to fall to the minimum entry price designated by EU officials to protect domestic producers. To determine if this is the case, the MIP for Turkish exports should be compared to the entry price of these exports. To do this we need a measure of the border price for Turkish tomato exports to the EU. As noted earlier, the European Commission calculates a c.i.f. value for imports by country of origin and exporters are given the right to check the compliance of their prices with commission-determined SIVs (standard import values). It is therefore assumed that the SIV for Turkish tomato exports can be used as an approximate border price. It is estimated that there exists a constant margin of 173 euros per ton between wholesale prices in Turkey and the entry price of Turkish tomatoes to the EU (i.e., SIVs) as wholesale prices are collected from the wholesale market and SIVs are published by the EU.

From table 1.8, it is estimated that the wholesale price in the Turkish market under a 15% price decrease in the EU market is 452 euros per ton. A wholesale price of 452 euros per ton implies an entry price (SIV) of 625 euros per ton (i.e., 452 + 173), which is lower than the minimum entry price of 771.4 Euros. The impact of this constraint on the welfare of different agents should be considered to arrive at a correct measure.

It is assumed that Turkish exporters will continue to supply just at the MIP, since they cannot supply at a price less than this minimum. This is equivalent to a shift in the Turkish supply curve which also means a decrease in aggregate supply within the EU. The decrease in aggregate supply created by the MIP regime increases domestic EU price and domestic producer surplus in the EU. The effect on the EU price and producer surplus depends on the share of Turkish tomato exports in aggregate supply. If the share of exports is relatively small, the increase in domestic price will also be small. The revised estimates for parameters of demand and supply and associated welfare estimates are presented below.

Table 1.9 Implications of a 15% decrease in price with a minimum import price in effect

	Intercept	Slope
EU Supply	-1,752,028	1,788
EU Demand	2,443,424	-996
Turkey's export supply	-8,821	8.2
EU aggregate supply	1,760,850	1,796
Equilibrium price (Euros/ton)	1,506	
Equilibrium demand (supply) (thousand tons)	943.9	
Exports from Turkey (thousand tons)	3.5	
Farm level supply price in the EU (Euros/ton)	526	
Wholesale price in Turkey (Euros/ton)	598	
Farmers' surplus in the EU (million Euros)	247	
Consumers' surplus in the EU (million Euros)	447	
Total surplus in the EU (million Euros)	694	
Wholesalers' surplus in Turkey (million Euros)	0.7	

Compared to the without the MIP regime, the estimates show that the welfare of EU farmers increases due to higher internal prices. Their welfare is 0.4 percent higher than without the minimum import price. However consumer surplus and exporter surplus decrease. Their welfare is 0.5 and 53 percent lower, respectively.

As the increase in producers' welfare is less than the decrease in consumers' welfare in the EU, the MIP regime is welfare decreasing due to its major effect on Turkish exporters. In the EU, compared to the same regime without MIP enforcement on exporters, total welfare decrease by only 0.1%, whereas, this percentage is 53% for welfare measured at the wholesale level in the exporting country.

iii) Concerned consumers leave the market entirely

In this section, it is assumed that because concerned consumers cannot determine the origin of the product, they stop consuming the product entirely. Based on the literature review earlier, it is assumed that 51% of EU tomato consumers will choose to leave the market in such a case. This response is reflected by a leftward shift in the demand curve until all concerned consumers leave the market, i.e., demand decreases by 51%. The numerical estimates for this case are shown in table 1.10.

Table 1.10 Impact of a 51% decrease in demand as concerned consumers exit the market

	Intercept	Slope
EU supply	-1,752,028	1,788
EU demand	2,057,833	-996
Turkey's export supply	-10,650	10.8
EU aggregate supply	-1,762,678	1,799
Equilibrium price (Euros/ton)	1,367	
Equilibrium demand (supply) (thousand tons)	697	
Exports from Turkey (thousand tons)	4.2	
Farm level supply price in the EU (Euros/ton)	387	
Wholesale price in Turkey (Euros/ton)	314	
Farmers' surplus in the EU (million Euros)	134	
Consumers' surplus in the EU (million Euros)	244	
Total surplus in EU (million Euros)	378	
Exporter surplus (million Euros)	0.8	

A comparison of the results when concerned consumer exit the market entirely to that in which they simply are only prepared to accept a discounted price shows that EU consumers and farmers both lose economic welfare. This is due to the larger price decrease brought by the substantial decrease in total demand (i.e. 51%), and the extent of the loss naturally depends on the parameters used in our example. Consumers' welfare is 76 percent lower compared to free trade, 46% lower compared to 15% decrease in price that concerned consumers are willing to pay, and 45% lower compared to 15% decrease in price with a minimum import price in effect. EU farmers' welfare 76% lower compared to free trade, 46% lower compared to 15% decrease in price that concerned consumers are willing to pay and 45% lower compared to 15% decrease in price with a minimum import price in effect. On the other hand, 51% decrease in demand is slightly better than a 15% decrease in price when minimum entry price is in effect for wholesalers in Turkey in terms of their economic surplus. Wholesalers' welfare increases 15 percent compared to the previous case with 15% decrease in price coupled with MIP. This result implies that the MIP system intensifies the welfare decreasing effect of a demand decrease for Turkish side.

iv) Minimum entry price enforcement for imports from Turkey when EU consumer demand decreases by 51%

The entry price for Turkish tomatoes into the EU violates the minimum entry price set by the EU when concerned consumers exit the EU market. As the minimum entry price remains the same, ceteris paribus, after the 51% decrease in EU domestic demand (at the level of 771euros per ton), the Turkish price at the wholesale markets falls to 314, which implies an entry price of 498, which is even less than the earlier entry price of 625 euros per ton. This creates a larger decrease in exporter welfare. As in the earlier case, we assume that export supply falls (the export supply curve shifts to the left) until the minimum import price is satisfied. This results in the following numerical results.

Table 1.11 Impact of a 51% decrease in EU demand with an effective minimum import price for Turkish tomatoes

	Intercept	Slope
EU supply	1,752,028	1,788
EU demand	2,057,833	-996
Turkey's export supply	-5,901	5.7
EU aggregate supply	-1,757,929	1,794

Equilibrium price (Euros/ton)	1,368
Equilibrium demand (supply) (thousand tons)	696
Exports from Turkey (thousand tons)	1.9
Farm level supply price in the EU (Euros/ton)	388
Wholesale price in Turkey (Euros/ton)	598

Farmers' surplus in the EU (million Euros)	135
Consumers' surplus in the EU (million Euros)	243
Total surplus in the EU (million Euros)	378
Exporter surplus in Turkey (million Euros)	0.3

As in the scenario in which the MIP is enforced with a 15% decrease in EU domestic price compared to 15% decrease in this price with an effective MIP, only EU farmers' welfare is positively affected in this scenario compared to a 51% decrease in EU demand without MIP effect. EU farmers' welfare increases 0.7%, consumers' welfare decrease 0.4%, and wholesaler welfare in Turkish markets decrease by 63% compared to a 51% decrease in demand without a MIP in effect. These relative changes when demand falls 51% without an effective MIP and with a MIP regime in effect shows that MIP's effect on welfare is the largest for wholesalers in Turkey. This large decrease in the surplus of Turkish exporters measured at the wholesale level can be explained by the substantial shift in the export supply curve that is needed to satisfy the minimum import price requirement in the EU. The shift depends on how much the Turkish export price would otherwise violate the minimum entry price, i.e., the difference between the MIP and the SIV. Since there is a larger decrease in the Turkish entry price when consumers withdraw from the market, the application of the MIP in this case causes a major decrease in exporter surplus is remarkable. There is almost a 70% decrease in the wholesaler welfare in Turkey from the enforcement of the MIP in the earlier case. On the other hand, consumer welfare in this case is 46% lower than the earlier case of MIP enforcement and producer welfare is 45% larger.

d) Market Segmentation through mandatory labeling

Labeling is a method of providing product-specific information to consumers and to reduce quality and safety uncertainty. The market for a product can be differentiated through labeling using direct indications of country of origin, quality, etc. In this scenario we examine mandatory labeling enforced on imported products.

Under the labeling scenario, we assume that there will be a higher priced market consisting of domestic supply and a lower priced one consists of foreign supply. If unconcerned consumers' demand is sufficiently larger than the foreign products entering their country, they will also demand some of the domestically supplied items.

Based on the reasons mentioned earlier, it is now assumed that the 51% of total tomato consumers, who are the concerned ones, are willing to pay 15% more for the domestic products than the unconcerned consumers. Below, there are empirical estimations for the concerned and unconcerned demand curves, their respective quantities and prices given the export and domestic tomato supplies:

Table 1.12 Impact of a mandatory labeling on tomatoes from Turkey

	Intercept	Slope
EU supply	-1,752,028	1,788
Concerned consumer demand	1,623,882	-442

Unconcerned consumer demand	1,560,201	-488

Equilibrium price-concerned (Euros/ton)	1,949
Equilibrium price-unconcerned (Euros/ton)	1,695
Equilibrium demand-concerned (thousand tons)	763
Equilibrium demand-unconcerned (thousand tons)	733
Farmers' surplus in the EU (million Euros)	629
Concerned consumers' surplus in the EU (million Euros)	658
Unconcerned consumers' surplus in the EU (million Euros)	551
Total consumer surplus (million Euros)	1,209
Exporter surplus in Turkey (million Euros)	3.2
Total surplus in the EU (million Euros)	1,838

Under this scenario, although unconcerned consumers in the EU are willing to consume imported tomatoes from Turkey, export volume is not enough to satisfy their demand. Under this market condition, these consumers end up consuming tomatoes produced in the EU together with concerned consumers and this additional demand coupled with higher prices paid by concerned consumers push up the retail level price of tomatoes in the EU from its free trade level (Retail level EU price for tomatoes are 2% lower under free trade).

All agents' observe an increase in their economic welfare, but exporters in Turkey compared to free trade. Although different surplus measures are estimated for the two groups of consumers, sum of the unconcerned and concerned consumers' surpluses is used to derive a welfare measure that represents EU consumers in general. This total consumer surplus is 0.19% higher than in the free trade. Tomato farmers in the EU also gain compared to free trade, farmers' welfare decreases by 0.12%. The combined effect of these increases in the consumers' and producers' welfare in the EU is a 0.17% increase in total surplus from the free trade level.

To sum up, under this scenario, higher welfare for domestic producers and more diversity for consumers are provided. In our case, imports of tomatoes from Turkey are relatively low compared to sales of domestically grown tomatoes in the EU. EU producers can now offer higher prices to concerned consumers and they are still able to sell a considerable amount to unconcerned consumers, implying an increase in their economic welfare. On the other hand, exporters' economic welfare decrease compared to free trade case without the labeling requirement, as concerned consumers are now able to differentiate the imported tomatoes in the market and they are no longer interested in buying them.

1.3.7 Summary of the results

A two-country partial equilibrium model is applied to Turkish fresh tomato exports to the EU. The implications of several consumer demand and policy scenarios are illustrated using base values for production and consumption in EU, exports from Turkey, the price of exports and domestic prices in the EU derived from various data sources along with assumed elasticities based on a review of previous studies.

Price and quantity equilibria and respective welfare for EU producers, wholesalers in Turkey, and EU consumers for seven different cases are examined: 1. autarky; 2. free trade; 3. free trade with heterogeneous consumers (the concerned group demanding a 15% decrease in price); 4. trade with heterogeneous consumers (with the concerned group demanding a 15% decrease in price) and an effective minimum import price on Turkish exports; 5. free trade with heterogeneous consumers (with the concerned group representing 51% of total consumers leaving the market); 6. trade with heterogeneous consumers (with the concerned group representing 51% of total consumers leaving the market) with an effective minimum import price on Turkish exports, and 7. trade with mandatory labeling on exports. The price decrease demanded by concerned consumers (15% from the free trade equilibrium price) and the percentage of the concerned consumers in total tomato consumers (51%) are based on a review of the literature.

The welfare estimates under the seven scenarios are shown in Table 1.13. First a welfare comparison between autarky and free trade scenarios is provided, then, EU consumer surplus, EU producer surplus, net surplus in the EU and wholesaler surplus in Turkey are compared to the results under free trade.

Table 1.13 Welfare changes

	EU producer	EU consumer	Net EU surplus	Turkish wholesaler	Net surplus
Case 1 Autarky					
	563	1,010	1,573	0	1,573
Case 2 Free trade					
	558	1,015	1,573	3.4	1,576.4
Change compared to autarky (%)					
	-0.88	0.49	0	na	0.22
Case 3 Heterogeneous consumers, 15% price decrease					
	246	449	695	1.5	696.5
Change compared to free trade (%)					
	-55.9	-55.7	-55.8	-55.9	-55.8
Case 4 Heterogeneous consumers, 15% price decrease, and MIP enforcement					
	247	447	694	0.7	694.7
Change compared to free trade (%)					
	-55.7	-56	-55.9	-79.4	-55.9
Case 5 Heterogeneous consumers, 51% demand decrease					
	134	244	378	0.8	378.8
Change compared to free trade (%)					
	-76	-75.9	-76	-76.5	-75.9

Case 6 Heterogeneous consumers, 51% demand decrease, and MIP enforcement				
135	243	378	0.3	378.3
Change compared to free trade (%)				
-75.8	-76	-82.3	-91.1	-76
Case 7 Trade with mandatory labeling on exports				
629	1,209	1,838	3.2	1,841
Change compared to free trade (%)				
+0.12	+0.19	+0.17	-0.06	+0.17

In Table 1.13, changes in welfare are estimated relative to the free trade scenario for each case (except for the free trade case which is compared to autarky); therefore, a comparison between all cases is meaningful.

Opening borders to fresh tomatoes from Turkey without any restrictions decreases producer surplus by 0.88% and increases consumer surplus by 0.49% compared to autarky. The magnitude of these changes should increase with the volume of imported tomatoes from Turkey. On the other hand, if EU consumers who have a preference against imported tomatoes push down the tomato price by 15% from its free trade level, both producer and consumer welfare decrease by 55.9 and 55.7 percents compared to free trade, respectively. If a minimum import price measure is applied on tomatoes from Turkey under this scenario, decrease in the producer surplus compared to free trade decreases (i.e., from 55.9% to 55.7%), and decrease in the consumer surplus increases (i.e., from 55.8 to 55.9). Wholesalers in Turkey lose both under 15% price decrease and 15% price decrease coupled with MIP enforcement compared to free trade, but their loss is larger in the latter case. Turkish loss at wholesale level is 55.9 and 79.4 percent, respectively. If EU consumers who are against the imported tomatoes leave the market entirely (i.e., if the demand decreases by 51%) the losses incurred at the wholesale level in Turkey are higher than under 15% price decrease.

Compared to free trade, Turkish wholesalers lose 55.9% of their economic welfare when price decreases by 15% from its free trade level. The decrease in Turkish wholesalers' welfare when consumer demand decreases by 51%, is 76.5%. MIP enforcement coupled with 51% decrease in demand results in the highest loss for Turkish wholesalers among all scenarios considered. Economic welfare in Turkey at the wholesale level decrease 91.1 percent compared to free trade if MIP is enforced on Turkish tomatoes and demand in the EU decreases by 51% as concerned consumers who do not prefer to consume tomatoes coming from Turkey leave the market.

EU consumers also lose if MIP is enforced on tomatoes from Turkey. Consumer loss under 15% price decrease scenario increase from 55.7% to 56% when MIP is enforced. In 51% demand decrease scenario, their loss increases from 75.9% to 76% when MIP is enforced. Tomato producers in the EU gain from MIP on tomatoes from Turkey, their loss decreases from 55.9% to 55.7% if MIP is enforced with 15% price decrease scenario, and from 76% to 75.8% with 51% demand decrease scenario.

Trade with labeling also decrease EU tomato producers' welfare approximately by 5.1% compared to free trade. Under the same scenario, consumers lose 1.9 of their welfare too. Despite losses incurred, labeling on Turkish exports is the best regime for EU producers and consumers if there is heterogeneity in preferences among EU consumers. Labeling policy being superior to other scenarios means that the proportion of concerned consumers is large enough to affect producer welfare significantly when no labeling exists. Also in our case, as Turkish imports are not enough to cover EU consumers' demand who are indifferent between domestic and imported tomatoes, these also consume higher priced domestic tomatoes. EU producers lose despite the lack of imports in this case, as consumers may not fully realize the lack of imports and continue holding their demand at a lower level.

To sum up, responses of concerned consumers affecting the market in the form of demand decrease are detrimental to all agents, both from the importing and exporting country. Decreases in welfare are larger if the concerned consumers leave the market altogether than the case where they stop consuming tomatoes until the price drops by 15% from its original level. On the other hand, enforcement of a minimum import price on the exporter increases the welfare of producers, while it decreases both welfare of EU consumers and Turkish wholesalers. In both cases of MIP enforcement (case 4 and 6), the only economic agent who gains is the domestic consumers.

1.3.8 Concluding remarks

This essay introduces a comprehensive approach for the analysis of combined effects of the recent trade barriers which are different than the traditional quota and tariff measures, such as minimum import price regime and food quality and safety related non-tariff measures. While analyzing effects of those policies on producers in the importing and exporting country, this approach considers heterogeneous consumer preferences for the imported product in the importing country and provides estimates also for the changes in consumer welfare. A partial equilibrium model is developed considering a single product exported from one country to another. Earlier approaches attempting such welfare analyses were either concerned on one side of the economy (i.e., concentrated on welfare changes of producers only), have not paid attention to the differences in preferences on the consumer side, or ignored the interactions between different policy instruments.

The general two-country partial equilibrium model outlined is applied to Turkish fresh tomato exports to the EU as fresh produce is the most vulnerable to food safety and quality measures among other agri-products and the EU is one of the most stringent countries in the enforcement of these. Together with the strict quality and safety measures, EU countries also apply a minimum entry price regime on tomatoes imported from Turkey. Evaluating the welfare consequences of these combined measures numerically are important for assessing the impact of quality and safety standards in importing countries where other barriers to trade are used.

The implications of several consumer demand and policy scenarios are illustrated and numerical results are compared between these scenarios. Compared to autarky, under free trade policy consumer welfare increased by 0.88%, and producer welfare decreased by 0.49% in the EU; and free trade policy created economic surplus of 3.4 million Euros for Turkey measured at the wholesale level. EU tomato farmers' welfare were the highest under autarky, followed by trade with mandatory labeling on tomatoes imported from Turkey; then, trade with heterogeneous consumers (when the concerned group demand a 15% decrease in price) coupled with an effective minimum import price on Turkish exports; free trade with heterogeneous consumers (when the concerned group demand a 15% decrease in price); then, trade with heterogeneous consumers (when the concerned group represent 51% of total consumers leaving the market) coupled with an effective minimum import price on Turkish exports, and it is lowest under free trade with heterogeneous consumers (when the concerned group represent 51% of total consumers leaving the market). This ranking of producer welfare in the EU suggests that MIP enforcement has a positive effect on producers, and it might be applied to offset some of the decreasing effects of consumer response that is in action if consumers cannot distinguish imported tomatoes from domestic ones. On the other hand, MIP enforcement on tomatoes from Turkey intensifies the existing negative effect of the fall in price/demand for tomatoes due to consumers' preferences against imported produce. Tomato exporters' welfare in Turkey at the wholesale level is the highest under free trade and continuously decreases starting from the case of 15% decrease in free trade price due to heterogeneity in consumer preferences until it reaches its lowest value under 51% demand decrease coupled with MIP enforcement. Welfare for wholesalers in Turkey is less than 10% of its free trade value in the last case.

Another important result derived is the MIP enforcements' negative effect on the consumers' economic surplus, increasing the price prevailing in the EU markets. Therefore, EU consumers' surplus is the lowest when 51% decrease in demand occurs coupled with MIP.

Further applications of this framework to different cases and different markets can provide valuable insights to its applicability and robustness.

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ESSAY 2

Changes in the Target Markets of Turkish Tomato Exporters: A Markov Process?

2.1 Introduction

Turkey has experienced a change in the distribution of its tomato exports among destination markets in recent years. Historically, European Union (EU) countries, Balkan countries, some countries of the Arabian Peninsula and the former Union of Soviet Socialist Republics (USSR) were the largest markets for Turkish tomatoes. Recently, some decrease in the volume of tomatoes exported to the far regions of the Arabian Peninsula such as Saudi Arabia, the United Arab Emirates (UAE), Qatar, Jordan and Kuwait has been recorded. Exports of tomatoes from Turkey to the Arabian region have dropped from approximately 68 thousand tons[16] in 2001 to 23 thousand tons in 2009 (UN ComTrade 2010). On the other hand, the years after the break-down of the USSR witnessed a rapid increase in the volume of tomatoes exported to the Russian Federation and to other former USSR countries such as Ukraine, Belarus and Kazakhstan. Exports to those countries increased from approximately 56 thousand tons in 2001 to 309 thousand tons in 2009 (UN ComTrade 2010).

This essay uses a Markov chain analysis to examine the nature of changes in the structure of Turkish tomato export markets. More specifically, in this study we try to understand whether differences in food safety and quality standards among destinations can be linked to the changes in their share in the total export value of Turkish tomatoes. Using a Markov chain analysis, we search for any evidence suggesting shifts in Turkish tomato exports towards low standard (in terms of food safety and quality) destinations. For this purpose, countries to which Turkey exports fresh tomatoes are aggregated into three groups based on their food quality and safety standards.

The first group (called the high standard group) includes countries with the highest incomes according to the World Bank (WB)[17] classification (World Bank 2010). Most of the

[16] The term "tons" is used in replacement of "metric tons" throughout this essay.
[17] The World Bank divides economies according to 2009 gross national income (GNI) per capita, calculated using the World Bank Atlas method. The groups are: low income, $995 or less; lower

countries in the first group are World Trade Organization (WTO) members and remarkable in terms of the application of very high standards, such as the EU member countries. This group also includes some non-EU countries that apply similar standards such as Israel and Switzerland (see Appendix A for a complete list). The second group (called the medium standard group) includes countries which are still conscious of the safety and quality of their food imports but not as much as the countries of the first group. Much of the countries in the medium standard group are also WTO members and belong to the upper/lower medium income group of the WB (e.g., Balkan countries, Croatia, Estonia). High income countries which do not apply such high sanitary standards as in Europe, such as Saudi Arabia, also belong to the medium standard group. Finally, the third group (called the low standard group) includes the former Soviet Union countries, which are both non-WTO members and the weakest in terms of their food quality and safety standards. Further details on the aggregation of the data used in this essay and the rationale for including countries in each of the three groups are discussed in section 2.3.

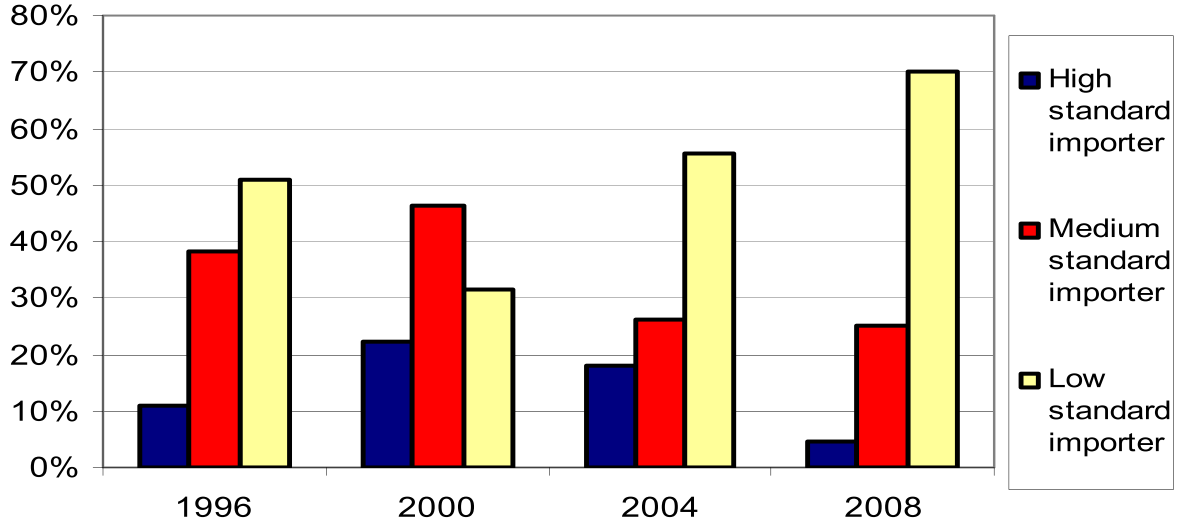

Figure 2.1 Share of markets by quality standards in the total value of Turkish tomato exports 1996, 2000, 2004, and 2008
Source: UN ComTrade 2010.

middle income, $996 - $3,945; upper middle income, $3,946 - $12,195; and high income, $12,196 or more.

Figure 2.1 shows each group's share (i.e., countries with the highest, medium and the lowest level of food quality and safety standards) in the total value of Turkish tomato exports for four-year intervals starting in 1996. Increase in the low standard importers' share of exports from 2000 to 2004 and from 2004 to 2008 can be observed from the figure. The decrease observed in the share of this group in the first quarter of the period is probably due to the serious economic crisis in 1998 that caused a significant depreciation in the value of ruble, the national currency of the Russian Federation. Hence, purchasing power from other countries, even in the value of Russian traditional exports like fresh fruit and vegetables dropped.

Figure 2.1 shows that the share of importers with the highest standards in the total export value decreased between 2000 and 2004 and also from 2004 to 2008. These high standard importers also had the lowest share in total Turkish tomato exports among all three groups for all the years considered.

The share of medium standard importers in the total export value of tomatoes from Turkey also decreased from 2000 to 2004 and from 2004 to 2008; however, the magnitude of this decrease is not as marked as in the case of high standard importers' share.

There are several possible reasons for the changes shown in Figure 2.1. Changes in demand conditions in importing countries, changes in the supply conditions in Turkey, changes in the unit prices of Turkish tomatoes, or changes in the world prices of tomatoes in general are the first ones that come to mind. To examine factors affecting importing country shares not directly connected to the economic environment in Turkey, changes in the values of total tomato imports of high, medium, and low standard country groups from 1994 to 2007 are discussed next (see Figure 2.2).

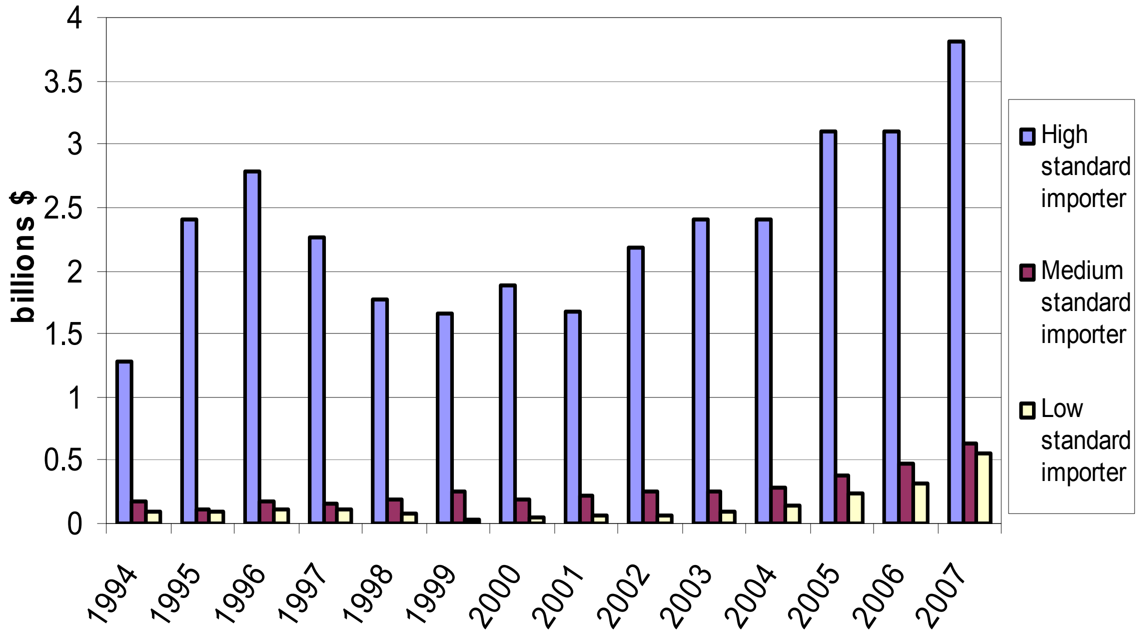

Figure 2.2 Value of high, medium and low standard importers' total imports, 1994-2007
Sources: UN ComTrade and FAO TradeStat 2010.

As may be seen from Figure 2.2 there has been a strong increase in tomato imports in the high standards group in recent years. However, Figure 2.1 shows that the largest increase in the export share for Turkey has been for tomatoes exported to low standard countries. Hence, changes in the share of tomato export values from Turkey to high standard countries has not developed in line with the changes in the total tomato import values of these countries. This is particularly noticeable after 2000. The observation of counter-cyclical changes in Turkey's tomato exports is also valid for medium standard countries. In contrast, the Turkish export share to low standard countries has increased with increases in total tomato imports of these countries. In Figure 2.2 above, it can be observed that the increase in tomato imports is a general phenomenon regardless of the status of importing countries for the period between 1994 and 2007. Therefore, it is difficult to argue that the concentration of growth in Turkish tomato exports to low standard countries is determined solely by demand factors. Possible changes in the supply parameters during the period from 1994 to 2007 are discussed next.

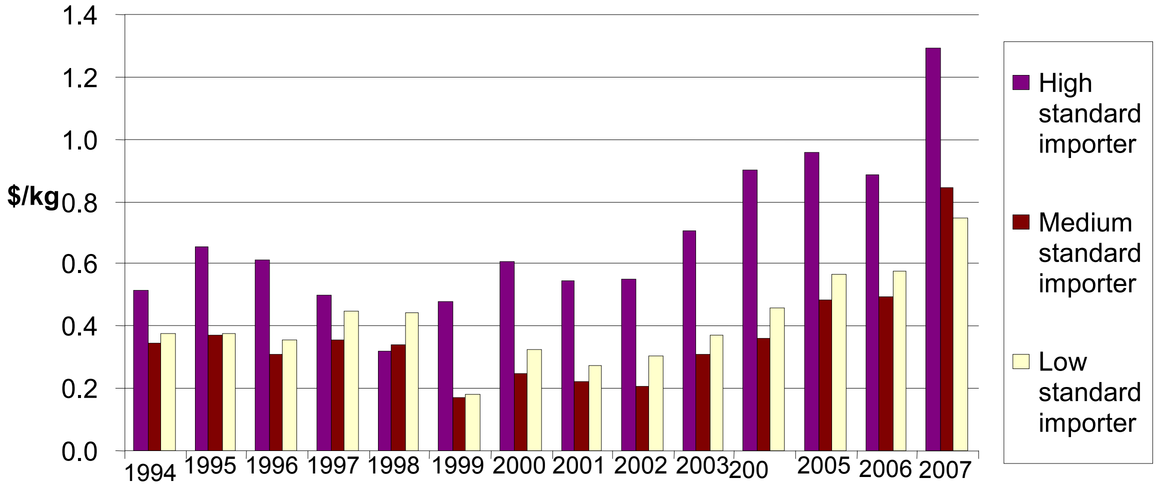

Figure 2.3 The unit prices of Turkish tomato exports in each importing country group, 1994-2007
Sources: UN ComTrade and FAO TradeStat 2010.

Unit import prices of tomatoes imported from Turkey show an increasing trend for each country group for most of the period from 1994 to 2007 (see Figure 2.3 above).

There are significant differences among the trends that the unit import prices of Turkish tomatoes follow in destinations differing in standards. In general, tomatoes exported to high standard destinations are higher priced than the ones exported to medium or low standard countries but this differentiation in pricing is possibly due to differences in quality of tomatoes. Therefore, differences in unit prices also do not provide a sufficient explanation for the shift of Turkish tomato exports between destinations having differing food quality and safety standards for the period considered. Thus, a Markov chain model is developed in this essay to examine different food quality and safety standards' effect on the destination shifts of tomato exports from Turkey.

In the following sections, A Markov model is applied to the shares of the three groups of countries in total tomato exports from Turkey to analyze the nature of changes in the Turkish export markets for the years 1994-2009. Previous uses of this model in agricultural economics are discussed in the next paragraph.

Historically, agricultural economists have been interested in summarizing how economic processes and institutions have changed through time as well as what paths they are likely to take in the future time (Judge and Swanson 1961). Judge and Swanson made suggestions on how to employ Markov models in this context. Markov models have been applied to project the number and size of the dairy firms in New York area by Stanton and Kettunen (1967), to the structure of the British dairy industry by Colman (1967), to analyze the changing farm structure in the UK by Power and Harris (1971) and to analyze the changing share of cotton in the US fiber market by Smith and Darris (1972). In the context of international trade, Atkin and Blandford (1982) analyzed changes in the composition of UK apple imports using a Markov model. Similar to Atkin and Blandford's study in 1982, Rees (2002) employed Markov analysis to investigate the changes in import market shares for suppliers of apparel to the US market. Most recently, de Morais and Portugal (2005) have applied the model to examine changes in the structure of Brazilian imports.

Before developing a Markov model to analyze the changes in Turkish tomato export markets, this essay provides a background on Markov chain models and describes the data used. Following the model development and introduction of data, results obtained are discussed.

2.2 The Markov Process

The Markov process begins with a defined set of discrete states such that each observation (for a country, firm, etc) can be classified into one of these. Assuming that there are R states, a matrix, which is called "the Markov transition probability matrix", can be defined. This transition probability matrix shows the probability of observations staying unchanged (i.e., remaining in their existing state) or transferring to one of the remaining (R-1) states.

Let N be the number of observations (entities, individuals, etc) and assume that the sequence of states occupied by each entity at discrete time points (let these time points be indexed as t = 0, 1, …, T.) can be observed. Also, let the number of times any observations move from state i to j in any one-step transition be denoted by n_{ij}. Then, the probability of an entity being in state j in period t, given that it was in state i in period t-1, can be estimated by the ratio:

$$p_{ij} = \frac{n_{ij}}{\sum_{k=1}^{R} n_{ik}} \quad . \tag{2.1}$$

In other words, the proportion of entities that started in state i and ended in state j to the proportion of all entities that started in state i, gives the probability of transition from state i to state j. This is a maximum likelihood estimator of the true transition probability and it is showed to be consistent, asymptotically unbiased, and asymptotically normal (Kelton and Kelton 1984).

However, it is often difficult to obtain disaggregated data to permit tracing the movement of individual entities from one group to another during a given time period, for example, the change in the size of a particular dairy farm in terms of the number of cows. Such micro data cannot be obtained in most cases. Even though the individual movement of entities from state to state is unobservable, the total number of entities that are present in each state in each time period is usually known – in our example, the number of farms in a particular size category defined by the number of cows.

Now, suppose the aggregate proportions in state i and state j are given by $Y_i\,(t\text{-}1)$, and $Y_j\,(t)$, at time t-1 and t, respectively, then, the following stochastic equation can be written:

$$Y_j(t) = \sum_i P_{ij} Y_i(t-1) + u_j(t) \quad . \tag{2.2}$$

P_{ij} above is the stationary probability of moving from state i to state j (note that it does not depend on time as does Y or u). Writing this equality in matrix form and addressing redundancy issues in the equation system, the starting point for MacRae's (1977) solution and quadratic programming algorithm might be derived as follows:

$$Y_*(t) = Y(t-1)P_* + \varepsilon_*(t) \ , \qquad 2.3$$

where, P is the matrix of transition probabilities $\{P_{ij}\}$, and $\varepsilon(t)$ is an error term vector that might occur due to sampling; $*$ indicates that the last element of Y (t) and $\varepsilon(t)$, and the final column of the transition probability matrix P are omitted to prevent redundancy in this equation system. In its open form, this system can be written as:

$$Y_* = [\ Y_1\ Y_2 \ldots\ Y_{R-1}\ ]'$$

$$= [\ Y_1(1)\ Y_1(2) \ldots Y_1(T) \quad Y_2(1)\ Y_2(2) \ldots Y_2(T) \quad \ldots \quad Y_{R-1}(1)\ Y_{R-1}(2) \ldots Y_{R-1}(T)\ ]',$$

$$Y(t-1)_j = \begin{bmatrix} Y_1(0) & Y_2(0) & . & . & . & Y_R(0) \\ Y_1(1) & Y_2(1) & . & . & . & Y_R(1) \\ . & . & . & & & . \\ . & . & & . & & . \\ . & . & & & . & . \\ Y_1(T-1) & Y_2(T-1) & . & . & . & Y_R(T-1) \end{bmatrix} \text{ for } j = 1,\ 2, \ldots, R\text{-}1 \ , \qquad 2.4$$

such that

$$Y(t-1) = \begin{bmatrix} Y_1 & 0 & . & . & . & 0 \\ 0 & Y_2 & . & . & . & 0 \\ . & . & . & & & . \\ . & . & & . & & . \\ . & . & & & . & . \\ 0 & 0 & . & . & . & Y_R \end{bmatrix},$$

and

$$P_* = [\ P_1\ P_2\ \ldots\ P_{R-1}\ ]'$$

$$= [\ P_{11}\ P_{21} \ldots\ P_{R1} \quad P_{12}\ P_{22}\ \ldots\ P_{R2} \quad \ldots \quad P_{1,R-1}\ P_{2,R-1} \ldots\ P_{R,R-1}, \qquad 2.5$$

$$\varepsilon_*(t) = [\ \varepsilon_1\ \varepsilon_2\ \ldots\ \varepsilon_{R-1}]$$

$$= [\ \varepsilon_1(1)\ \varepsilon_1(2)\ \ldots\ \varepsilon_1(T) \quad \varepsilon_2(1)\ \varepsilon_2(2)\ \ldots\ \varepsilon_2(T) \quad \ldots \quad \varepsilon_{R-1}(1)\ \varepsilon_{R-1}(2)\ \ldots\ \varepsilon_{R-1}(T)\ ]'. \qquad 2.6$$

Lee, Judge and Zellner (1970) were the first to suggest that the solution to this problem can be obtained (i.e., the elements of the probability matrix P can be estimated) by minimizing the sum of squared residuals of the system. Kelton (1981) suggested a quadratic programming approach to minimize the sum of the squared residuals. The quadratic programming problem is written as

$$\text{Minimize} \quad \sum_{t=1}^{T}\left(\left[Y_*(t) - P_*'Y(t-1)\right]'\left[Y_*(t) - P_*'Y(t-1)\right]\right) \qquad 2.7$$

with respect to $\{P_*\}$

subject to

$$\sum_{j=1}^{R-1} P_{ij} \leq 1 \ , \qquad 2.8$$

and

$$P_{ij} \geq 0 \ . \qquad 2.9$$

In matrix terms, the objective function above is equal to the sum of squared residuals that is minimized using the quadratic programming algorithm indicated.

In minimizing the objective function, the two constraints in the system (inequalities 2.8 and 2.9), need to be satisfied. As P_*' is an s-1 dimensional vector of transition probabilities (assuming R is the total number of states, there can be up to R-1 transitions between these), the rows of P must sum to 1 in every period and each entry in the probability matrix representing an individual probability of transition should be less than one and greater than zero (or equal to 1 or 0 as limiting cases).

Note that the numerical computing environment called matrix laboratory (MatLab) contains an optimization tool (OptimTool) which allows the solution of such quadratic optimization problems under inequality and bound constraints. MatLab is employed in this essay as a convenient estimation tool.

A model that is stochastic in nature (i.e., Markov chain analysis) is chosen as the methodology, as a change in the target market mix does not involve a one time, discrete shift from a region to another. Prior to changes in destination, supply chain relations need to be established, risks of alternative markets need to be evaluated, and adaptation to each region's standards and demand needs to be achieved. This can be captured through the Markov approach. Another reason for the use of the Markov chain analysis is the limited nature of the data. Only aggregate data on exports (volumes, values or destinations) are available rather than exact firm-level transactions by destination (micro data). Using aggregate frequency data between specific regions in each exporting year permits us to derive an approximation to the firm level behavior under similar circumstances.

2.3 Data

The raw data used in estimation consist of the value of Turkish tomato exports (in US dollars) to each destination country. These data is collected from the United Nations Commodity Trade Statistics Database (UN ComTrade) for the period from 1994 to 2009. Although it is possible to collect earlier historical data from ComTrade, the starting year of 1994 is chosen because this marks the beginning of significant structural changes in Turkey's export markets such as the emergence of the Russian Federation, the unification of Germany, and the dissolution of Yugoslavia.

First of all, summing these values of Turkish tomato exports to its partner countries, a total value for Turkish tomato exports is derived for each year in the period from 1994 to 2009. Next, dividing values of Turkish tomato exports to individual countries by its total value of tomato exports, share of each country (on average a total of 41 countries) in the total value of Turkish tomato exports is estimated. After these initial estimations, those 41 countries are aggregated into three groups by quality standards, and the share of each country in a group is summed up and this sum is used to represent the groups' share. However, the country composition of the groups does not remain stable; the country data used to derive each group's aggregate can vary over time. A country transfers from one group to another if the conditions affecting the safety and quality standards for its imports change over time (for example, Czech Republic changes groups as its income level, EU membership status, thus standards change after 2006). Another factor affecting composition of the groups is the changing composition of Turkish tomato export destinations; Turkey does not have a stable set of countries to which it exports tomatoes (for example, Turkey exports tomatoes to Spain only in 4 of the 16 years considered).

In the literature, various rationales are given for aggregating countries into groups in the analysis of international trade. Criteria such as the level of economic development, geographical considerations, geo-political linkages have previously been used for this purpose. In this essay, the approach taken by Wang and Caswell (1998) is employed. In their paper Wang and Caswell (1998) compared levels of food safety regulations in Asian countries to which the US exports food items, aggregating these countries into three groups mainly based on their income levels as: 1. newly industrialized countries (South Korea, Taiwan, Hong Kong, and Singapore); 2. Asian developing countries (China, Thailand, India, and Philippines); and 3. Japan. They suggest that high income countries also follow high level of food safety standards and use these as non-tariff barriers to trade.

Following Wang and Caswell (1998) and assuming that trade policies applied on Turkish tomato exporters are the main determinant of their transition decisions among destinations, 41 export destination countries for tomatoes from Turkey are grouped according to their standards for safety and quality. Since trade in fresh tomatoes is of concern here, it is suggested that a country which wants to protect its consumers from low quality, health-risky exports, or whose consumers are well educated and aware of these risks, legislates high level of non tariff barriers applied to fresh product imports. These countries share common characteristics: they have high incomes, such as EU countries, Israel, USA etc, and they are usually relatively open to trade in terms of tariff-related measures. Based on these observations, it is assumed that trade policies applied to tomatoes change as incomes change, such that countries are divided into two groups based on their income level: high income countries and others. Some countries such as Poland, Slovenia and Austria moved from middle to high income levels during the period from 1994 to 2009; and in such cases, these countries are also shifted between groups in this essay.

While belonging to the high income group, countries such as Saudi Arabia, Qatar and Kuwait have lower levels of sanitation as measured by World Health Organization (WHO), which is an indicator of the lower concern for the health of the population. A report in a national newspaper in Saudi Arabia (Saudi Gazette) dated June 30, 2010, talking about the first international food safety conference supports this view. At this conference which was held in Riyadh on May 30, 2010 and in Jeddah on May 31, 2010, speakers from the Saudi Food and Drug Authority, Saudi Arabian Standards Organization and other international organizations discussed issues related to the Saudi food industry with special emphasis on consumer health. The newspaper report after finalization of the conference suggests that the basic aim of the seminar was to create awareness among Saudi consumers and food manufacturing and processing companies of the importance of food safety. The report notes that "a large number of consumers in the country are not aware of what food safety is all about" (Front page, Saudi Gazette Online Version, June 30, 2010). An anonymous food consultant referred to in the article adds that food companies and producers in Saudi Arabia often claim to have quality certifications for their products when, in fact, they do not. Saudi Arabia is a recent WTO member (2006) and it requires only a phyto-sanitary certificate issued by the inspectors in the country of origin for consignments of fresh produce. Although the country imports much of its fresh fruit and vegetable consumption, less stringent standards coupled with a lack of consumer education makes this country an easier export destination for Turkish tomato exporters. Thus, such countries including Saudi Arabia are not classified as the high standard, but placed in the medium standard group. The other countries included in this group are the Balkan countries of Albania, Bulgaria, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Romania, and TFYR Macedonia; and some other countries that are neighbors of those Balkan countries such as Georgia, Slovenia, Slovakia, Lithuania, Latvia, Czech Republic, Hungary and Poland. Other countries in the Arabian Peninsula and some countries which are neighbors of the Arabian Peninsula are also in this medium standard group such as Lebanon, Kuwait, Iraq, Iran, Qatar, United Arab Emirates, and Jordan. The final group is composed of countries in which food safety and quality standards appear to be given low priority; they are called low standard countries in this essay. These countries, all of which are non-WTO members are the easiest to export to for Turkish tomato exporting firms. This low-standard group consists of former Soviet countries. The largest country in this group is the Russia Federation, and the others are Kazakhstan, Belarus, Ukraine and the Republic of Moldova.

To sum up, mainly based on income levels but also considering the importance given to food safety and openness to trade, countries to which Turkey exports tomatoes are aggregated into three groups called high, low, and medium standard groups. The composition of these groups is not constant over time as countries can move from one group to another depending on changes in their level of income and application of food standards. Thus for example, Slovenia is transferred from the medium standard group to the high standard group of countries in 1997, as it became a member of the WTO on July, 1995, and classified as a high income country by the World Bank in 1997. Another example is Estonia which is classified as a high standard country starting from 2006; as it is classified as a high income country in the same year. Slovakia, Croatia, Czech Republic are the other countries that moved from the medium standard group to high standard group at some point over the period under consideration. On the other hand, it is assumed that Ukraine has recently started to update its trade regime since it became a member of the WTO on May, 2008; and it is now less likely that its policy on food imports will share similar characteristics with the other former Soviet countries. Allowing for some time for the realization of the effects of changes in its trade policy, Ukraine is assumed to be a medium standard country as of 2009.

2.4 Findings

Kelton's (1981) method of estimation, outlined in the system 2.7 - 2.9 is applied to the data on the shares of country groups' import values in total imports of tomatoes from Turkey. The resulting transition probability matrix is shown in Table 2.1.

Tests need to be conducted on the stationarity of the transition probabilities in the table. It is possible that these probabilities have changed over time, and if this is the case, the factors responsible for the change would need to be identified. Kelton and Kelton (1984) suggest a method for testing the null hypothesis that the transition probabilities are stationary over time.

Table 2.1 Estimated transition matrix for Turkish tomato export destinations, 1994 to 2009

Groups		To		
		High standard region (EU and others)	Medium standard region (Balkans and countries of the Arabian Peninsula)	Low standard region (Russia and other former Soviet countries)
From	High standard region (EU and others)	0.68	0	0.32
From	Medium standard region (Balkans and countries of the Arabian Peninsula)	0.077	0.7	0.223
From	Low standard region (Russia and other former Soviet countries)	0.007	0.227	0.766

Source: Own estimations

The period for which data are collected is divided into two equal length sub-periods, and transition probabilities are estimated for each sub-period to apply the stationarity test. The null hypothesis is:

Ho = Pij (e) = Pij (f) for all i, j ,

where e stands for the early time instants (t = 1, 2,...,T/2), and f is used for later time instants (t = T/2+1,...,T) .

The unrestricted sum of squared residuals is defined as:

SSRu = SSRu (e) + SSRu (f) ,

where SSRu (e) is the sum of squared residuals from the quadratic programming (QP) problem detailed before but for t = 1, 2, …, T/2, and SSRu (f) is the sum of squared residuals from the same quadratic problem for t = T/2+1, …, T.

The restricted sum of squared residuals is defined as:

SSRr = the sum of squared residuals from the QP problem where t=1,2,...,T .

The test statistics is then constructed as follows and is distributed by Fq,v:

$$F_{q,v} = \frac{(SSRr - SSRu)/q}{SSRu/v} , \qquad 2.10$$

q = R(R-1) for this problem (i.e., number of additional restrictions imposed by H_0.), and v = T(R-1) - 2R(R-1) (i.e., number of independent observations minus the number of parameters estimated in the unrestricted case).

For the data employed, the test statistic equals to 0.45, while critical F value at the 0.05 significance level is 2.13. As the test statistic is smaller than its table value, the null hypothesis of stationary probabilities cannot be rejected at the 0.05 confidence level.

A review of the stationary transition probability matrix in Table 2.1 provides valuable insights into the shifts in destination markets for tomatoes from Turkey. For example, the diagonal entries of the matrix represent the probability that exports will continue to be directed to the same destination, in other words, the diagonal probabilities can be interpreted as the probabilities of remaining “loyal” to the destination market of the diagonal. These probabilities are all quite high (all of them are approximately 0.7), suggesting that there is a tendency towards a stationary trend in remaining loyal to each market over the time period considered. The tendency towards loyalty is highest for the low standard, former Soviet countries, followed by exports to the medium standard region. The group for which Turkish exporters demonstrate the least loyalty is the high standard, i.e., there was a probability of 0.68 that Turkish tomato exports directed to the high standard region would continue to be directed to that region throughout the period analyzed.

However, it is important to note that the likelihood of exports being shifted from both the medium standard and high standard regions is quite pronounced. The probability of transfer from high standard to low standard markets is 0.32, and the probability of transfer from medium standard markets to low standard markets is 0.22.

In contrast, the likelihood of shifts in the reverse direction (i.e., from a market with lower quality standards to one with higher standards) is quite low. Exporters shipping to the low standard region either continued to direct their export s to that region remained in their low standard region or possibly shifted to the medium standard region. They were extremely unlikely to shift to the high standard region. The likelihood of exports directed to the medium standard region being shifted to the low standard region was also high (0.223), but this was balanced by a slightly larger probability of a shift in the opposite direction, (0.227). Particularly noticeable is the high probability of transfer from the high standard to low standard region. The balance between the probabilities of shifts in exports between the high and low standard regions is clearly in favor of a shift from high to low quality. The pronounced difficulty in changing destination markets from low standard to high standard is consistent with the view that differences in the food safety and quality standards have had an effect on export decisions by Turkish exporters. The results suggest that shifting from the former Soviet countries to EU markets was either too difficult or not profitable for Turkish tomato exporters and that while the tendency was for exporters to focus primarily on expansion in medium to low quality markets. This is in conformity with the idea presented earlier in this essay that the Turkish tomatoes have competitive advantage in Russian markets. Tomato exporters interviewed in Antalya (the highest volume of tomatoes are exported to Russia from Turkey are produced in this province of Turkey) expressed the opinion that it is more difficult to supply tomatoes to the EU countries with high standards than to former Soviet countries which are low in standards. These exporters also reported that the tomato producers who follow the EU quality and safety standards are not numerous in Turkey and it is costly to invest in testing of the produce as a truckload of tomatoes may contain products from at least 15 different farmers due to the small and fragmented structure of farms. On the other hand, although the legislation on pesticide residues in the imports of fresh produce lists much lower maximum residue levels (MRLs) for exporters, enforcements at the Russian border suggest that it is easier for Turkish tomato exporters to evade these high standards as illegal mechanisms such as bribing are common in Russian markets. Fresh produce export experts from the Turkish Ministry of Agriculture interviewed indicated that major retailers increasingly started to determine minimum standards by making their own, higher regulations following their customers' demand. As a result, fewer chemical residues are allowed in the fresh produce imported, creating difficulties for Turkish exporters mostly buying from farmers lacking these higher safety and quality standards in their production.

2.5 Conclusions

The findings in this essay are consistent with the view that the stringency of quality and safety standards for agricultural produce imports has had an impact on the structure of Turkey's tomato exports. Higher transition probabilities from high standard to medium and low standard groups are estimated for Turkish tomato exporters. There is an almost zero probability of transition from low and medium standard groups to the high standard group which is consistent with the view expressed by those interviewed in Turkey on the difficulty of satisfying the highest level standards. Turkish tomato exporters working with low standard countries have a very high probability of remaining loyal to those markets, and if they seek to develop their exports elsewhere, this is more likely to be in markets having medium, rather than high quality standards for imports. \

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-APPENDIX A-

Destination markets for tomatoes from Turkey grouped with respect to their food quality and safety standards, 1994-2009

Years	Groups
1994	High standard countries: Austria, Belgium-Luxembourg, Cyprus, Denmark, Germany, Greece, Israel, Japan, the Netherlands, Portugal, Spain, Sweden, Switzerland, the United Kingdom. Medium standard countries: Croatia, the Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Saudi Arabia, Slovenia, TFYR Macedonia, Albania, Bulgaria, Georgia, Iraq, Jordan, Kuwait, Lebanon, Qatar, United Arab Emirates. Low standard countries: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova.
1995	High standard importers: Austria, Belgium-Luxembourg, Canada, Cyprus, Denmark, France, Germany, Greece, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, the United States of America. Medium standard importers: Croatia, the Czech Republic, Hungary, Lebanon, Lithuania, Poland, Romania, Saudi Arabia, Syria, Slovenia, TFYR Macedonia, Albania, Bulgaria, Georgia, Iraq, Kuwait, Qatar. Low standard importers: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova, Belarus.
1996	High standard importers: Austria, Belgium-Luxembourg, Cyprus, Denmark, France, Germany, Greece, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, the United States of America, Ireland, Italy. Medium standard importers: Croatia, the Czech Republic, Hungary, Poland, Romania, Saudi Arabia, Slovenia, TFYR Macedonia, Albania, Bulgaria, Bosnia

and Herzegovina, Georgia, Iraq, Kuwait, Qatar, Lithuania, Saudi Arabia, Serbia and Montenegro, Slovakia, United Arab Emirates.

Low standard importers: Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

1997 High standard importers: Austria, Belgium-Luxembourg, Cyprus, Denmark, Germany, Greece, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, the United States of America, Slovenia.

Medium standard importers: Croatia, the Czech Republic, Azerbaijan, Hungary, Poland, Romania, Saudi Arabia, Slovakia, Georgia, TFYR Macedonia, Albania, Bulgaria, Bosnia Herzegovina, Saudi Arabia, Slovakia, United Arab Emirates.

Low standard importers: Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

1998 High standard importers: Austria, Cyprus, France, Germany, Greece, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Ireland, Slovenia.

Medium standard importers: Croatia, the Czech Republic, Hungary, Poland, Romania, Saudi Arabia, Azerbaijan, TFYR Macedonia, Albania, Bulgaria, Georgia, Kuwait, Oman, Saudi Arabia, Slovakia, United Arab Emirates, Bosnia and Herzegovina, Serbia and Montenegro.

Low standard importers: Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

1999 High standard importers: Austria, Cyprus, Denmark, France, Germany, Greece, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Ireland, Slovenia, Italy.

Medium standard importers: Croatia, the Czech Republic, Hungary, Poland, Romania, Saudi Arabia, Serbia and Montenegro, TFYR Macedonia, Albania, Bulgaria, Georgia, Kuwait, Qatar, Saudi Arabia, Slovakia, United Arab Emirates, Azerbaijan, Bahrain, Bosnia and Herzegovina, Jordan, Oman.

Low standard importers: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

2000 High standard importers: Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Sweden, Switzerland, the United Kingdom, Cyprus, Slovenia, Malta.

Medium standard importers: Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kuwait, Lithuania, Oman, Poland, Romania, Saudi Arabia, Slovakia, United Arab Emirates, TFYR Macedonia, Serbia and Montenegro.

Low standard importers: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

2001 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Slovenia, Malta.

Medium standard importers: Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Iran, Jordan, Kuwait, Latvia, Lithuania, Malaysia, Oman, Poland, Qatar, Romania, Saudi Arabia, Slovakia, United Arab Emirates, TFYR Macedonia, Serbia and Montenegro.

Low standard importers: Belarus, Ukraine, the Russian Federation, the Republic of Moldova.

2002 High standard importers: Austria, Belgium, France, Germany, Greece, Israel, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, Cyprus, Slovenia.

Medium standard importers: Albania, Algeria, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kuwait, Latvia, Lithuania, Oman, Poland, Qatar, Romania, Saudi Arabia, Slovakia, United Arab Emirates, TFYR Macedonia, Serbia and Montenegro.

Low standard importers: Ukraine, the Russian Federation, the Republic of Moldova.

2003 High standard importers: Austria, Belgium, Cyprus, France, Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Slovenia.

Medium standard importers: Albania, Azerbaijan, Bahrain, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Iraq, Kuwait, Latvia, Lithuania, Malta, Oman, Poland, Qatar, Romania, Saudi Arabia, Slovakia, United Arab Emirates, TFYR Macedonia, Serbia and Montenegro.

Low standard importers: Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

2004 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, Slovenia.

Medium standard importers: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Iraq, Kuwait, Latvia, Lithuania, Oman, Poland, Qatar, Romania, Saudi Arabia, Slovakia, United Arab Emirates, TFYR Macedonia, Serbia and Montenegro.

Low standard importers: Belarus, Ukraine, the Russian Federation, the Republic of Moldova.

2005 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, Slovenia.

Medium standard importers: Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Iraq, Kuwait, Latvia, Lithuania, Poland, Romania, Saudi Arabia, Slovakia, United Arab Emirates, TFYR Macedonia, Serbia and Montenegro.

Low standard importers: Belarus, Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova.

2006 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, the Netherlands, Italy, Norway, Sweden, Switzerland, the United Kingdom, Slovenia, Estonia.

Medium standard importers: Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Iraq, Kuwait, Latvia, Lithuania, Montenegro, Poland, Romania, Saudi Arabia, Serbia, Slovakia, United Arab Emirates, TFYR Macedonia

Low standard importers: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

2007 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Slovenia, Italy, Estonia, Czech Republic.

Medium standard importers: Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Georgia, Hungary, Iraq, Kuwait, Latvia, Lithuania, Montenegro, Poland, Romania, Saudi Arabia, Serbia, United Arab Emirates, TFYR Macedonia.

Low standard importers: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

2008 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, Israel, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Ireland, Slovenia, Croatia, Czech Republic, Estonia, Slovakia, Hungary

Medium standard importers: Albania, Azerbaijan, Bahrain, Bosnia and Herzegovina, Bulgaria, Georgia, Iran, Iraq, Kuwait, Latvia, Lithuania, Montenegro, Poland, Qatar, Romania, Saudi Arabia, Serbia, Singapore, Syria, United Arab Emirates, TFYR Macedonia.

Low standard importers: Kazakhstan, Ukraine, the Russian Federation, the Republic of Moldova, Belarus.

2009 High standard importers: Austria, Belgium, Cyprus, Denmark, France, Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, Ireland, Slovenia, Slovakia, Croatia, Czech Republic, Malta, Latvia.

Medium standard importers: Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Georgia, Hungary, Iraq, Kuwait, Lithuania, Montenegro, Poland, Romania, Saudi Arabia, Serbia, Syria, TFYR Macedonia, Ukraine.

Low standard importers: Kazakhstan, the Russian Federation, the Republic of Moldova, Belarus.

ESSAY 3

The Exporter's Decision Problem of Compliance with Importers' Standards

3.1 Introduction

The growth of global trade in fresh agricultural produce has brought attention to the great divergence in national standards for food safety. There are several reasons why food safety and health standards differ across countries. Differences in tastes, diets, income levels, and perceptions influence people's tolerance of risks (Unnevehr 2003; Jaffee and Henson 2004). Due to weaknesses in physical infrastructure, some of the risks associated with food safety may be higher in developing countries. When such institutional and technological weaknesses are combined with rising compliance costs, the exporters of fresh produce look for opportunities to escape from the burden of quality and safety standards. The ability of exporters to avoid standards depends on many factors such as the probability of inspection or detection of non-conformity with the standards, expected costs in case of rejection, and the existence of alternative markets in which to sell the produce if it is rejected at a given destination.

Turkish tomato exporters face different levels of challenge in terms of compliance with safety and quality standards in their two major destination markets – the EU and Russia. Differences in food safety and quality standards and enforcement levels between these markets are discussed next.

In EU markets (i.e., in the individual countries of the Union), there is common legislation for labeling, plant health, hygiene, the use of genetically modified organisms (GMO) and pesticide residues. EU Member States inspect imported produce at its first point of entry to the EU. If, on inspection, the produce is found not in conformity with EU standards, the consignment may be: 1) denied entry; 2) downgraded but allowed to enter; 3) re-sorted so that any conforming part is allowed entry; or 4) rejected for return to its origin, for redirection to non-EU destinations or destroyed. Certification using Hazard Analysis and Critical Control Point (HACCP) methodology and the Global Partnership for Good

Agricultural Practice (GlobalGAP) program are generally used by exporters to assure EU members of the quality and hygiene levels of imports.

From the perspective of exporters of fresh produce, a key set of legislation regulating EU imports concerns maximum allowable residue levels (MRLs) for pesticides and other chemicals. This special legislation (see European Commission 2008) sets the maximum residue level for each pesticide and each product and these levels are constantly renewed. The interviews conducted suggest an agreement between trade experts in Turkey and EU officers that the largest proportion of rejections of consignments from Turkey concerns food contaminants, such as veterinary drug residues, pesticide residues, and mycotoxins. Turkish interviewees indicated that restricted contaminants are widely used by farmers as they are inexpensive and government controls to limit their use or to control applications at the farm level are inadequate.

Turkish exporting firms find it quite difficult to satisfy the demand for high quality tomatoes from EU countries; most firms complain that this is their most serious challenge in working with EU countries. The Turkish Ministry of Agriculture requires farmers to comply with a set of minimum standards on the use of pesticides, but even these minimum standards are not fully enforced. An exporter rarely invests in testing his/her produce for pesticide residues before making a buying decision. Testing consignments is costly given that truckloads may contain produce from 15 to 20 farmers due to the small and fragmented farm structure in the industry. Exporters selling to the EU choose either to buy repeatedly from the same farmers, whom they believe are trustworthy in terms of following standards or produce their own tomatoes to reduce the risks involved. Interviews revealed that exporters are increasingly interested in producing their own tomatoes to overcome risks and their associated costs. Buying from producers with certificates recognized at the EU border (such as GlobalGap and HACCP, as noted earlier) is considered to be an almost risk-free option for exporters specializing in EU markets; but certified producing firms are not numerous in Turkey.

Interviews also indicated that exporters working with EU countries struggle to ensure that their produce is safe and of high quality before a consignment reaches the EU border, because the consequences of being found to be in non-compliance can be serious. From the exporters' point of view, the most serious result is not the costs of a particular incident, such as the costs of destruction or penalty fees, but the loss of credence with buyers. EU policy on actions taken when non-compliance is detected supports this view. EU countries employ a system called "the rapid alert system for food and feed" (RASFF) which involves the exchange of information with all member countries in cases where a risk to human health has been identified and measures have been taken, such as withholding, recall, seizure or rejection of products (see European Commission 2009). The rapid exchange of information allows EU Member States to verify immediately whether they are also affected by the problem that has been detected. If a product is already on the market but should not be consumed, the Member States' authorities are in a position to take urgent measures, including giving direct safety warnings to the public, if necessary. RASFF is also used intensively to follow up on reported problems. As a consequence, an exporting firm whose products are inspected in one EU country and found to be in non-compliance cannot re-export its produce to any other EU member country. What is more, EU controls will be intensified on future shipments from a firm that is found to be in non-compliance. If that firm is a supplier for a private market chain within the EU, which is often the case, it is highly likely that existing contracts will be terminated with the risky supplier. In summary, the results of being found to be in non- compliance in the EU are costly due to the lack of alternative markets in the short run and due to the loss of EU outlets in the long run.

Interviews with traders suggest that inspections and the consequences of being caught in case of non-compliance are much more flexible with respect to the Russian market; the other key outlet for Turkish tomatoes. Paradoxically the official standards, especially those for maximum allowable residue levels, are nominally more stringent in the Russian Federation than in the EU, but the actual enforcement of these standards is weak. Bureaucratic corruption and illegal activities compromise the actual stringency of Russian standards on imported produce. An inspector at the Russian border may be induced to shut his/her eyes to a consignment that does not meet the required standards. The corruption already existing in the Russian market is intensified through the practices of Turkish firms who work as wholesalers in the Russian terminal markets in coordination with Turkish exporters. Such wholesalers are often willing to purchase whatever an exporting firm offers, providing that the price is sufficiently attractive, without paying too much attention to quality. Such behavior nullifies the potential role of wholesale buyers in Russia as a second level shield against low quality produce after border inspections.

Finally, even if exports are denied entry at the Russian border, they are often redirected to Bulgaria or Romania, to be subsequently re-exported to Russia. Observing this trend among Turkish exporters, the Russian Government recently banned the importation of fresh fruit and vegetables produced in Turkey from Bulgaria, but the regulation is not actually enforced, as verification of country of origin is not easy. If they cannot re-export rejected produce for some reason, Turkish exporters can still ship products back for sale in the domestic market. These practices supply the exporter and the farmer with short-term profits, but in the long-term, they are impediments to the development of Turkish agriculture. The results of the rejection of consignments might be worse for exporters from Turkey in the future if Russian authorities start to tighten up the inspection process.

With this background, the remainder of this essay examines the decision on whether or not to comply with an importer's requirements by focusing on a representative Turkish tomato exporter's decision problem in two different markets. The focus is on the costs and benefits of compliance and the ranking for these in two alternative markets – the EU and

Russia. Two dynamic choice models are developed in which an exporter faces different probabilities of inspection and different consequences from non-compliance. The problem is dynamic in the sense that current decisions of the exporter on compliance might have future consequences such as more stringent inspections, or a need to leave the market due to losses from the destruction of product at some point, etc.

As with many other decision-making problems in agriculture, the problem is stochastic. The frost-protection and fallowing-planting problems are examples that have been studied earlier (e.g., Katz, Murphy, and Winkler 1982; Brown, Katz, and Murphy 1986; and Mjelde et al. 1988). Another common feature of these decision problems is that they are repetitive (farmers face the same decision at the beginning of each season or over a given interval repeatedly) and most of the time, decisions at a current state depend on previous decisions and also affect future decisions. Previous studies show that a sequence of static optimal decisions is not always equivalent to the optimal decision in a dynamic context. That is, if repeated decisions are related, a dynamic model should be developed.

Recently, dynamic decision models have been applied to more diverse agricultural problems. For example, Brummet and Richardson (2008) modeled stochastically the citrus growers' decision problem of whether to invest in disease-resistant citrus cultivars in Florida. Producers face risk from current diseases and they make choices to protect their cultivars. Improved, disease-resistant cultivars are proven to prolong tree life but a considerable amount of investment is required to adopt these varieties. These costs and risks associated with disease in the area affect farmers' optimal decisions.

Quiroga and Iglesias (2009) derived analytical expressions for a farmer's optimal policy with minimum expected expense to manage climate risk in agriculture in a dynamic cost-loss model with finite horizon. They concluded that there exists a threshold probability for adverse weather, only after which it is optimal for the farmer to take protective action.

In the following sections of this essay, dynamic cost-loss modeling will be applied to the decision problem for an exporter on whether to comply with an importer's food quality and safety standards.

3.2 A discrete compliance model for food quality and safety standards

In this model, an exporter has two options: 1) he will comply with the requirements of the importer; or 2) he will not comply with the requirements. In this respect, this exporter is faced with a discrete problem. No matter what he decides to do, he faces two possible outcomes at the importer's border: 1) his consignment will be rejected; 2) his consignment will be accepted for entrance. And, if the result is rejection, he will destroy the product.[18]

Let us denote the cost of compliance as cX, where X is the quantity of exports. It is assumed incurring this cost c in any given period precludes any losses for that decision period. If the exporter is able to get his consignment through the border (either by complying with the standards or avoiding them without being caught) he can sell his produce at a rate of a per unit of produce, thus total earnings will be aX ($a > c$).[19]

On the other hand, if the consignment is rejected at the border, the exporter pays a destruction fee of d per unit of product. Further assume that probability of inspection (i.e., the probability being caught and destruction in case of non-compliance) is p.

Let us assume that the exporter's objective is to maximize total expected net revenue (i.e., total expected revenue – total expected costs) over some finite number of periods[20]. Each period is indexed by t ($t = 1, 2, \ldots, (n-1), n$). Let us assume further that the

[18] In some cases, exporters can re-export their consignment to a less stringent country in terms of import standards or simply return the product to the domestic market (if the condition of the consignment allows) in order to reduce the loss. For the sake of simplicity we consider that only the destruction option is available here, although other considerations will not alter the nature of the analysis.
[19] Note that coefficient a should be larger than c as positive profits for exporter should exist for trade to occur.
[20] Maximizing total expected net revenues is equivalent to minimizing total expected costs for this problem. The maximization problem is specified for a small business that is already in the export sector (i.e., fixed costs are ignored) such that it has finite lifetime and limited capital. The decision maker is assumed to be risk neutral.

maximization problem in each individual period is not independent from one another because the exporter can only incur further losses (i.e., negative net revenues) if this would not cause him to have a total negative net revenue. That is to say, the exporter can only continue trading in period t if and only if:

$NR_{t-1} + NR_t \geq 0 \qquad t = 2, 3, \ldots ,(n-1), n$,

where

$$NR_t = R_t - C_t \quad . \qquad 3.1$$

NR stands for total (expected) net revenue, R is revenue, C is cost, and t is the subscript for the decision period as noted earlier.

As both costs and revenues are defined per unit of produce (i.e., they increase proportionately with the increase in the quantity of exports), the total quantity of exported produce does not affect the exporter's compliance decision. As costs of transportation, packaging and all other applicable export costs are incurred regardless of that decision; they also have no effect on the decision of the exporter and are therefore omitted.

To begin with, the problem is structured for two decision periods; the problem with n periods is developed next.

Optimization with 2 periods (t = 1, 2)

In period 2, (or in the last decision period, in general), the exporter knows that he will not be confronted with a choice of compliance for another period. Therefore, the decision to be made for the last period (second one in this case) can be thought to be a static one. To start with, the structure of this static decision problem is discussed. First, total expected revenue resulting from potential compliance and non-compliance is derived.

(i) Expected net revenue in the second period if the exporter decides to comply with the importer's standards is

$$aX - cX = (a - c)\,X \,, \quad 3.2$$

where revenue aX is from the sale of the X quantity of product and cost cX is incurred for compliance, $a > c$.

(ii) Expected net revenue in the second period if the exporter decides not to comply with the standards is:

$$p\,(-dX) + (1 - p)\,(aX) \,. \quad 3.3$$

With probability p, consignment will be inspected and destroyed at the border, and with probability (1 - p), the consignment will not be inspected. In the latter case, there are no costs of compliance and no losses due to destruction.

Next, given these total expected net revenues depending on the exporter's choices, the static decision problem is written as a maximization problem:

$$NR_1 = \text{Maximum}\left\{ (a - c)\,X \;;\; p\,(-dX) + (1 - p)\,(aX) \right\}. \quad 3.4$$

The first term in brackets above is the expected revenue in case of compliance and the second term is the expected revenue in case of non-compliance in period 2. One may be larger than the other and this depends on the relative values of the variables p, a, c and d. The exporter should be indifferent between complying and non-complying if the expected net revenues resulting from either decision is equal such that:

$$(a - c)\,X = p\,(-dX) + (1 - p)\,(aX) \,.$$

The X's cancel out and the equation becomes

$$(a - c) = (-d + a)\,p + a \,,$$

such that

$$p^* = \frac{c}{d + a} \,. \quad 3.5$$

The threshold probability level above which the optimal decision should be to comply and below which it should be not to comply is denoted by p^*. Knowing that it is optimal to comply with the importer's standard if $p > p^*$, and not to comply with if $p < p^*$ in period 2, alternatives for the first period are considered, moving backwards in time.

At this point, it should be noted that the exporter continues to the second period only if the net revenue of the preceding period is positive (due to the assumption 3.1., i.e., $NR_{t-1} + NR_t \geq 0$). If the exporter does not comply and is caught in the first period, he will incur a loss of dX with probability p. This means that with probability p, there will not be a decision for the remaining period (i.e., second period) as it is impossible for the sum of the two periods' revenues to be positive in this case. On the other hand, with probability (1 – p), the exporter will be confronted with a decision for the second period. For the two periods, the following maximization problem is valid, which is written using the earlier solution for the static one period solution (hence the subscript 1) NR_1:

$$NR_2 = \text{Maximum} \left\{ (a-c)\,X + NR_1 \; ; \; p\,(-dX) + (1-p)\,(aX) + (1-p)\,NR_1 \right\} . \qquad 3.6$$

The first bracketed term is expected total revenue if the exporter complies in the first period and second term is the expected total revenue if the exporter does not comply in the first period.

After specifying the problem, a solution scheme can be defined as follows:

(1) $p > \dfrac{c}{d+a}$, i.e., the exporter will comply with the standards in the second period (unless he is caught in the first period). Assume first that the exporter complies in the first period, too. If this is the case, total net revenue for the two periods will be 2 (a – c) X. As a second option, the exporter may not comply in the first period, and the overall expected net revenue in this case is:

$$p\,(-dX) + (1-p)\,(aX) + (1-p)\,(a-c)\,X \; . \qquad 3.7$$

p (–dX) corresponds to being caught in the first period with probability p and (1 - p) (aX) corresponds to the situation of making profit aX without being caught in the first period. If the exporter is not caught, he will then make $(a - c)$ X profit in the next (second) period of compliance.

Thus, the exporter should protect himself from being caught in the first period if:

$2\,(a - c)\,X \;>\; p\,(-dX) + (1 - p)\,(aX) + (1 - p)\,(a - c)\,X$,

(since the expected compliance revenue should be larger to make a compliance decision)

or

$$p > \frac{c}{(2a + d - c)} \quad . \qquad 3.8$$

If the first period problem was also a static one the rule would be $p > \frac{c}{d + a}$. Thus, any anticipation on what could happen in the second period is altering the threshold probability of compliance.

(2) $p < \frac{c}{d + a}$ i.e., the exporter will not comply with the standards in the second period. If he/she protects himself in the first period, expected net revenue will be (a - c) X + (1 – p) aX – p (dX) . ((a – c) X is the net revenue if compliance takes place on the first occasion, aX will be earned with probability (1 – p) and dX will be lost with probability p on the second period of non-compliance afterwards). If the exporter does not protect on the first occasion, overall expected net revenue will be (1 – p) aX – p (dX) + (1 – p) [(1 – p) aX – p (dX)] as with probability (1 – p) the exporter will not be caught and realize the revenue aX, with probability p he will be caught and pay dX in the first period, only if he is not caught will he continue to the second period (with probability (1 - p)) and realize the expected net revenue (1 – p) aX – p (dX) under non- compliance on the second occasion.

Thus the exporter should comply in the first period only if

$(a - c)\,X + (1 - p)aX - p\,(dX) \;>\; (1 - p)\,aX - p\,(dX) \;+ (1 - p)\,[\,(1 - p)\,aX - p\,(dX)\,].$

which simplifies to

$$p\left[(2a + d) - (a + d)p \right] > c \ ,$$

or

$$p > \frac{c}{(2a + d) - (a + d)p} \ . \qquad 3.9$$

Recall that, from the start, it is assumed that $p < \frac{c}{d + a}$ (non-compliance in the second period). For both inequalities to hold, the denominator of the first expression should be smaller than the second one, as the nominators are the same and equal to $c > 0$.

$$(a + d) > (2a + d) - (a + d)p \ ,$$

which simplifies to the inequality below:

$$p > \frac{a}{a + d} \ . \qquad 3.10$$

Now we have two inequalities contradicting each other:

$$p < \frac{c}{d + a} \ \text{ and } \ p > \frac{a}{d + a} \ ,$$

These cannot hold at the same time as $a > c$.

Therefore, it is never optimal to comply in the first period if the exporter does not comply in the second period. That is to say, if $p < \frac{c}{d + a}$ the exporter should not comply in both periods.

The n period case (t = 1, 2, ... , (n-1), n)

Following the same logic developed above at each step, we can determine expected total net revenue for three periods, four periods, so on. Below is the recursive representation for n periods in total, written in terms of the total expected net revenue of the $(n - 1)^{th}$ period (One can derive this expression replacing n with 2 and (n-1) with 1 in the indices of NR):

$$NR_n = \text{Maximum} \left\{ (a - c)X + NR_{(n-1)} \ ; \ p(-dX) + (1 - p) * (aX) + (1 - p) NR_{(n-1)} \right\} . \qquad 3.11$$

The maximum expected total net revenue can be written for any desired number of n occasions. Likewise, suppose the exporter tries to decide in the k^{th} period (from the end of the decision horizon); it should be optimal to comply with the standards if the following holds:

$$(a-c)*X + NR_{(k-1)} > p*(-dX)+(1-p)*(aX)+(1-p)*NR_{(k-1)} \ ,$$

Rearranging, the inequality becomes:

$$cX < p(dX + aX + NR_{(k-1)}) \ . \qquad 3.12$$

Above, $d > a > c$, and $NR_{(k-1)}$ is a non-increasing function of k, therefore, depending on the magnitude of p, some value k should exist, denoted by k_0 such that the optimal decision is to comply for some $k_0 > k$ and not to-comply for some $k_0 < k < n$. In other words:

$$cX < p(dX + aX + NR_{(k-1)}) \text{ for } k_0 > k \ , \qquad 3.13$$

and

$$cX > p(dX + aX + NR_{(k-1)}) \text{ for } k_0 < k < n \ . \qquad 3.14$$

Assume that the probability that equates the expected net revenues of compliance and non-compliance is denoted by p^{**}. The two inequalities above state that there should be a time period k, before which the optimal action is not to comply and after k, compliance is optimal until the end of the horizon.

In reality, probability of being caught might increase over time, if exporter gets caught and is proven to be a non-compliant; the frequency of inspection is likely to increase. If this happens, the exporter should revise his decision. Let $p = p_0$ be the initial, regular probability of inspection before any finding of non-compliance. After the exporter is caught $p = p_1$ and $p_1 > p_0$. If $p_1 < p^{**}$ (i.e., if the increased probability of inspections after being caught is still less than the threshold probability), the exporter will not make a revision to the decision of not to comply, assuming p_1 stays the same in the future, he will never comply with the standards, now or in the future. If $p_0 < p^{**} < p_1$, the exporter does not comply until being caught, but if he is caught once, he starts to comply until the end of the exporting horizon.

3.3 A continuous compliance model for food quality and safety standards

Although the model of compliance developed above implicitly assumes that standards are well defined, such that an exporter should either comply with them completely or not comply at all, the actual enforcement of standards may vary from one region to another. In some countries, although the export standards are well defined, their enforcement is never complete in practice. If the supervision of inspectors at the border is also not very strict, although a consignment may lack some relatively insignificant requirements, a border officer might ignore the problem and let the exporter's consignment enter the country. However, in this case too, the probability of destruction or acceptance depends on the severity of non-compliance as the inspector may also want to cover risks of his own non-conformity. Under such a scenario, compliance and inspection should appear endogenously in the compliance model

With this scenario, the compliance level is a continuous variable rather than a clear-cut, discrete one and the expected cost of non-compliance is a function of this non-compliance (or compliance) level. The earlier model of discrete compliance is altered for this case in the following paragraphs.

Let *l* be the level of compliance (defined in terms of per unit cost of compliance) in this new model. The probability of inspection, and therefore, the expected cost of non-compliance are then defined as a function of the compliance level as p(*l*)[21].

---

[21] The probability function *p* now satisfies the following properties:

(1) $\frac{\partial p}{\partial l} < 0$, (2) $0 \leq p \leq 1$, (3) $l \rightarrow \bar{l}, \quad p \rightarrow 0$, (4) $l \rightarrow 0, \; p \rightarrow 1$, (5) $0 \leq l \leq \bar{l}$.

Under this problem, the exporter is not confronted with a discrete choice to maximize expected net revenue, he invests in meeting standards, no matter what, and it is the rate of compliance that differs between periods such that:

$$NR_{cont} = (1 - p(l))\, aX - p(l)\, dX - lX \quad , \qquad 3.15$$

In the equation above, NR_{cont} stands for the net revenue under continuous decision process; p is the probability of inspection, a is the revenue per unit of X units of consignment, d is the per unit cost of inspection as defined earlier, and *l* stands for the level of compliance (i.e., per unit compliance cost). The exporter chooses the level of investment in meeting standards per unit of consignment; hence he chooses the chances of acceptance and destruction of the portions of his consignment. If he invests l_1 amount per unit of produce, he earns $(1 - p(l_1))$ aX and loses $p(l_1)$ dX through inspections, but he does not lose all of his consignment due to flexibility in the enforcement of the standards.

Then, the optimal compliance level is the one that maximizes NR_{cont} is

$$\underset{\{l\}}{\text{Max}}\,(NR_{cont}) = \frac{\partial NR_{cont}}{\partial l} = X(-p'(l)a - p'(c)d - 1) = 0 \ . \qquad 3.16$$

Then, l^* is the optimal level of compliance such that $p'(l^*) = -\frac{1}{(a+d)}$.

If the probability density function p is also known, the exact value of *l* can be specified. This probability function should change from case to case, however it should satisfy the aforementioned properties in each case. Here, an example is given using one of the simplest forms possible for satisfying the desired properties.

$$\text{Let} \quad p(l) = \sqrt{(1-(\frac{l}{\bar{l}})^2} \quad , \qquad 3.17$$

so that

$$p'(l) = \frac{1}{2}\left[1-(\frac{l}{\bar{l}})^2\right]^{-1/2} \left[-2(\frac{l}{\bar{l}^2}) \right] = -\left[1-(\frac{l}{\bar{l}})^2\right]^{-1/2} (\frac{l}{\bar{l}^2}) \leq 0 ,$$

i.e, the probability function p(l) is decreasing in l.

Here, $\bar{l}$ denotes a maximum compliance level, in other words, it is the highest per unit cost of compliance which occurs when all standards are met. Also, at the maximum compliance level of $\bar{l}$, the probability becomes 0, and when l is zero the probability is 1. Thus, the defined function satisfies the required properties.

At the optimum compliance level (l^*), we know that $p'(l^*) = -\frac{1}{(a+d)}$.

As the actual probability density function is now specified, the l^* that yields the maximum total net revenue can be explicitly derived given a, d, and c:

$$-\left[1-(\frac{l^*}{\bar{l}})^2\right]^{-1/2} (\frac{l^*}{\bar{l}^2}) = -\frac{1}{(a+d)} , \qquad 3.18$$

Taking squares of both sides:

$$\left\{ \left[1-(\frac{l^*}{\bar{l}})^2\right]^{-1/2} (\frac{l^*}{\bar{l}^2}) \right\}^2 = \left\{ \frac{1}{(a+d)} \right\}^2 , \qquad 3.19$$

Rearranging equation 3.19:

$$\left[1-\frac{1}{\bar{l}^2}(l^*)^2\right]^{-1} \frac{1}{((\bar{l})^2)^2} (l^*)^2 = \frac{1}{(a+d)^2} . \qquad 3.20$$

Solving this equation for l^*, an optimal compliance level in terms of the maximum possible compliance level, and profit and cost coefficients can be determined as:

$$l^* = \bar{l}^2 \sqrt{\frac{1}{\bar{l}^2 + (a+d)^2}} \quad . \qquad 3.21$$

3.4 Applications

In this section of the essay, the analytical expressions developed above are applied to a representative Turkish tomato exporter exporting to two destinations with different intensities for the enforcement of standards. As noted earlier, EU and Russian markets differ in terms of their enforcements of standards for Turkish tomato exporters. While inspection and close follow up exist in EU markets, bureaucratic corruption and bribes compromise the actual stringency of Russian standards. In addition, a customs inspector might shut his eyes to a consignment that does not meet the required standards. Therefore, the model which treats compliance as a discrete choice problem is more appropriate for EU export markets, whereas, the continuous choice model is more appropriate for the more flexible Russian markets.

3.4.1 Optimal compliance policy in EU markets

Generally speaking**,** EU countries are more stringent in terms of requirements for the quality and safety of food than many other countries. This suggests that high standards are consistently and rigorously enforced at the border; any item that does not meet the required standards is either destroyed or accepted as a lower quality item, depending on the significance of the standard that is not met in terms of human health. Therefore, in EU markets, Turkish tomato exporters are faced with a discrete choice in terms of compliance: they either comply with all or do not comply with any of the standards. In this section, the discrete model of compliance will be applied to EU data.

In order to apply the outlined compliance decision model, the unit price of tomatoes (a), per unit compliance costs (c), per unit destruction costs, and probabilities of destruction should be known. It was not possible to access any recorded data on inspection probabilities from the importer side or destruction costs from the exporter side as these are issues that the parties involved prefer not disclose. The best approximation available was the results provided by Antalya Provincial Control Laboratory, an institution approved by the Turkish Accreditation Authority to test products destined for export to the EU. Table 3.1 below shows result of tests conducted only on a portion of the produce exported, since such tests are voluntary and do not include tomatoes but also other varieties of fresh fruit and vegetables. The numbers suggest very low rates of non-conformity with EU standards. Recognizing that these may be biased downwards, we are forced to use these as an approximate for the probability of destruction in examining optimal compliance policy for an exporter.

Table 3.1 Pesticide residues analysis results for fresh tomatoes in Antalya Province, Turkey

		Years				
		2002	2003	2004	2005	2006
Results	Total	158	169	369	463	1401
	Positive	123	152	367	459	1391
	Negative	35	17	2	4	10
	Probability of a negative result	35/158	17/169	2/369	4/463	10/1401

Sources: Asci 2009 and Ministry of Agriculture, Turkey 2007.

Some information on costs and earnings were derived from interviews with tomato exporters in Antalya, Turkey. Exporters have a cost of both meeting the standard (i.e., compliance) and proving their compliance (i.e., certificating) with the standards. Therefore, the coefficient c of the model should include both. Table 3.2 below presents representative information on the price structure of tomatoes to export in Antalya, Turkey (based on a normalized raw exporter cost of 1TL per kg) for 2009.

Table 3.2 Price formation of Turkish tomatoes at the importer level in the EU market in 2009

Producer's price	: 86.9 kurus[22]
Wholesaler's commission	: 15% (13.1 kurus)
Exporter's raw cost	: 100 kurus
Labor costs	: 7 kurus
Firm related costs	: 4 kurus
Turkish customs clearance + packaging + initial analysis in Turkey	: 30 kurus
Certification costs	: 3.5 kurus
Extra packaging + labeling	: 12 kurus
Total compliance and certification related costs	: 45.5 kurus
Total costs before profit	: 156.5 kurus
Compliance costs as a percentage of total costs before profit	: 29%
Exporter's profit margin	: 2%
Price to importer	: 159.63 kurus

Source: Interviews with tomato exporters in Antalya Province, Turkey.

Despite lack of evidence on per unit destruction costs, this should be larger than the value of the produce as the exporter loses all the produce and has to pay for disposal on top of that loss. Assuming the costs of labor required during the exportation process are a reasonable proxy for the amount of labor required for destruction, the cost of the destruction process itself should be at least 7 kurus, or approximately 4.5% of the total exporter cost before any profits.

Based on the values in table 3.2, it is assumed that a the per unit price of tomatoes equals 159.63 kurus, c (per unit cost of compliance with importers' standards) equals 45.5 kurus, and d (per unit destruction cost) equals 163.5 kurus. As there is no information on the actual probabilities of inspection, no specific decision rules could be estimated, but the threshold probability of inspection that the exporter should consider can be derived. From

[22] All prices are in kurus (100 kurus = 1 Turkish Lira) and per kilogram.

equation 3.6, it is known that the threshold probability is equal to c / (a + d), or 0.14 for a Turkish exporter sending his/her produce to the EU.

A threshold probability of inspection which equals 0.14 means that if the actual probability faced by a Turkish tomato exporter is higher than this value, an exporter would be better off if he complies with EU standards , on average (since the compliance model developed rests on expected values). If, on the other hand, the actual probability is less than 0.14, the exporter would expect to be better off in not complying with the EU's food quality and safety standards.

For inspection probabilities over 0.14, the optimal policy for Turkish tomato exporters is to comply with EU countries' food safety and quality standards. At first sight this might be considered a low figure, but it would mean that roughly 15% of all consignments of tomatoes would have to be evaluated in terms of their conformity with EU standards, including conformity with pesticide residue requirements.

3.4.2 Optimal compliance policy in Russian markets

The stringency of the application of food quality and safety standards and the frequency of border inspections in the Russian market are lower than in the EU. Turkish tomato exporters' choice of action in response to Russian food quality and safety standards is not limited to a discrete choice as in the EU. If tomatoes are only lacking in terms of some standards, they can still be accepted for entry at the Russian border. This is because customs officers in Russia are not limited by law (i.e., they can be persuaded to shut their eyes to a consignment's non conformity with some standards through bribes, etc.). Given this flexibility in the enforcement of standards in Russia, exporters can adjust their compliance level considering the inspection probability, compliance and certification costs and profits. In this section, a choice model is developed for Turkish tomato exporters to Russia, which takes into account this continuous nature of compliance behavior.

Compliance and certification costs for exporting tomatoes to the Russian Federation are generally lower than those for EU markets. This is because retailers and/or wholesalers in Russia request less certification and labeling (HACCP and GlobalGap certificates are rarely a prerequisite for entrance to Russia). On the other hand, prices are also lower. Although the actual costs and revenues are not known for the Russian market, a comparison can be made using the values for the EU market shown in table 3.2. To start with, costs and revenues in EU market are used in calculations and these are then altered to explore differences in compliance behavior.

As noted earlier, the core difference between the EU and Russian export markets lies in the fact that in Russia, while an exporter may choose to comply with the standards, he does not have to comply fully as entry is still probable in case of incomplete compliance. Moreover, the exporter still has the choice of not complying with any standard, which is the minimum level of compliance possible: 0. On the other hand, if he is willing to comply completely, he should invest the total amount of compliance cost per unit, which has been termed above as the maximum compliance level and denoted by $\bar{l}$. The strength of the optimal compliance level can be measured relative to this complete scheme. Recall that the optimal level of compliance (l^*) is defined in terms of the maximum compliance level ($\bar{l}$), price (a), and destruction costs (d) per unit of exports earlier:

$$l^* = \bar{l}^2 \sqrt{\frac{1}{\bar{l}^2 + (\mathrm{a}+\mathrm{d})^2}} \quad .$$

If the prices and costs per unit were the same in the two markets (EU and Russia):

$$l^* = \bar{l}^2 \sqrt{\frac{1}{\bar{l}^2 + (159.63 + 163.5)}} = \bar{l}^2 \sqrt{\frac{1}{(\bar{l}^2 + 323.13}} \quad ,$$

where $\bar{l}$ is equal to total per unit of cost of compliance in the EU, i.e., $\bar{l}$ = 45.5.

$$l^* = (45.5)^2 \sqrt{\frac{1}{(45.5)^2 + (323.13)}} = 41.4 \text{ kurus} \ .$$

In other words, if costs and profits are assumed to be the same between the EU and Russian markets, the compliance level is 91% (of the maximum compliance level possible).

Now, let the maximum compliance cost be 30 kurus in Russia (lower than the 45.5 for the EU). Price is also expected to be lower than in the EU market, thus let be equal to 140 kurus in this market. Destruction costs are assumed to be higher than the price offered to importers in both countries, so let us assume this to be 150 kurus in Russia; a reduction in line with the lower price level assumed. Now, the effect of the lower compliance and market prices in Russian markets to the optimum compliance can be estimated:

$$l^* = 30^2 \sqrt{\frac{1}{30^2 + (140 + 150)}} = 900 \sqrt{\frac{1}{900 + (290)}} = 25.2 \ .$$

The optimum compliance level is 84% of the maximum possible if costs and prices are lowered. Therefore, even if the EU operated a continuous compliance regime, the cost and price parameters would force Turkish tomato exporters to comply more in the EU market than in the Russian market.

3.5 Concluding remarks

In the final essay, different compliance models are developed for an exporter subjected to costly food quality and safety standards in importing countries. Two compliance models are developed because an exporter faces different levels of food quality and safety standards, and different consequences from non-compliance in these markets. In one market, the exporter faces a discrete choice of either complying or not complying with existing standards (hence, a discrete model of compliance applies), in the other market the application of standards is such that that the exporter can choose the level of compliance level (a continuous model of compliance applies).

The discrete compliance is applied to real world data to examine the optimal compliance decision for a Turkish tomato exporter exporting to the EU. The continuous model is applied to data for a Turkish exporter exporting tomatoes to the Russian Federation. Assuming the same compliance and non-compliance costs, the models suggest that the compliance level is less than complete for Russia (94%); on the other hand, the probability level of inspection at which exporters start to comply is low for EU export market (0.14) (see Mwebaze et. al 2010 for a comparison). In other words, Turkish tomato exporters who focus on EU markets are likely to be more cautious than the ones who send their produce to the Russian Federation, i.e., they do not wait until the probability of inspections increases to a high level to start protecting themselves from the significant costs of compliance. On the other hand, the probability of being rejected and hence incurring destruction costs is very low in the Russian Federation. In Russia, if the exporter complies with some of the standards while ignoring the more costly and difficult ones, the chances are high that his consignment will be accepted. Therefore, compliance is not complete and is determined by the exporter depending on relative costs and expected gains.

When the estimations are repeated for Russian tomato markets using lower estimates for compliance costs and revenues, the compliance level (defined as the ratio of maximum compliance level possible, 100%) is shown to decline.

These estimates are illustrative of the choices faced by Turkish exporters in these two important markets and the results obtained provide an insight into why exporters may choose to direct their products to markets that have a more flexible approach to the application of standards. However, the actual empirical results are highly dependent on the probability density function assumed for inspections. They also depend on costs and gains, for which there are no reliable data.

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