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THE AGE-CRIME RELATIONSHIP ACROSS TIME AND OFFENSE TYPES: A COMPARISON OF THE UNITED STATES AND TAIWAN

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ABSTRACT

Although scholars agree that crime tends to rise and peak in adolescence or early adulthood and decline afterwards, there is a contentious debate in the criminological literature about whether and to what extent the shape or form of the age-crime curve varies across historical periods, geographic locations, and crime types. The *invariancy* view, most strongly articulated by Hirschi and Gottfredson (1983), is that the age-crime relationship is universal and invariant across all social and cultural conditions and all social groups at all times. Writers holding the *variancy* position contend (e.g., Greenberg 1985; Steffensmeier, Allan, Harer and Streifel 1989; Tittle and Grasmick 1998) that there is fact considerable variation across crime types and across countries or historical periods. A central feature of this debate concerns whether development increases youth crime involvement and then changes the age-crime distribution. The present study addresses these issues by examining the age-crime relationship in Taiwan over the period of 1961-1991. Taiwan is a strategic research site mainly because it has undergone considerable development over the past several decades and, in fact, has moved from being classified as a *developing* nation to a *developed* nation.

Specifically, four hypotheses guide the research: (1) comparing age-crime distributions in Taiwan over the entire1960-1990 time frame, the distributions shift to a younger distribution with development; (2) based on both Taiwan and US arrest data, the age-crime curves in both nations should move to a younger distribution and peak earlier in the process of development; (3) due to cultural differences, there might be variations between Taiwan's age-crime curves and the United States' age-crime curves even at

similar level of development; (4) markers of development predict changes (if they have occurred) in the age-crime distribution over the 1960-1990 period. Descriptive techniques and advanced time-series analysis are applied to examine these hypotheses. Overall, the results indicate that for general property offenses (except typical adult crime such as fraud), Taiwan's age-crime curves have shifted to a younger age distribution over this time period as predicted by the *variancy* position. Moreover, the forces of development are especially useful for explaining these shifts. Such shifts and effects of development are not found for violent offenses and total offenses, which may be at least partially due to the continuity of traditional Chinese culture.

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Any errors are of course my own.

Chapter 1

Introduction

Age is one of the most visible social markers for human beings and also among the most complex and puzzling variables with which social scientists deal. For a long time, Western scholars have noted the age-crime relationship, that crime tends to rise and peak in adolescence or early adulthood, and then to more or less decline across the remaining life course (Parmelee 1918; Sutherland 1947; Lemert 1951). There is disagreement, however, about whether and to what extent the *shape or form* of the age-crime curve varies across historical periods, geographic locations, and crime types. One view, most strongly articulated by Hirschi and Gottfredson (1983), is that the age-crime relationship is *universal and invariant* across all social and cultural conditions, and all social groups, at all times. Other writers contend (e.g., Greenberg 1985; Steffensmeier, Allan, Harer and Streifel 1989; Tittle and Grasmick 1998) that there is, fact, considerable variation across crime types and across countries or historical periods in the parameters of the age-crime curve (e.g., peak age, median age, rate of decline from peak age). Therefore, a claim of "universality" or "invariancy" in the age-crime relationship is questionable.

A central feature of this debate concerns the impact of *industrialization* or *development* on the age-crime relationship. As I elaborate below, on theoretical grounds, it is often assumed that youth account for a smaller proportion of crime in developing than in developed nations because preindustrial societies provide for a smoother

transition between periods of youth and adulthood. That the passage to adult status is relatively simple and continuous in preindustrial societies apparently helps to avoid, or diminish, the status ambiguity and stresses of youth that have been noted since ancient times. In contrast, the social processes that are associated with industrialization and postindustrialization have aggravated these stresses, resulting in increased levels of juvenile criminality in developed nations and in recent decades. The structure of modern societies, therefore, encourages youth crime and delinquency because these societies "lack institutional procedures for moving people smoothly from protected childhood to autonomous adulthood" (Nettler, 1978:241; see also Steffensmeier et al. 1989).

Unfortunately, due largely to the shortage of appropriate data on age-specific offending levels, there is a scarcity of research examining the age-crime relationship across population groups or historical periods. This paucity of research is evident both in a general sense, considering research on age-specific offending, but even more so as regards the effects of development on age-crime distributions. Quite simply, except for developed countries like the United States and England, very few countries in the world provide counts of criminal offending broken out by age groups.

The present study helps fill these gaps in the research literature by examining the age-crime relationship in *Taiwan* over the 1961-1991 time frame. Taiwan is a strategic research site because (1) of its difference from Western societies. Taiwan is a typical Eastern society and its traditional Chinese culture might mitigate the effects of modernization on the age-crime relationship; (2) Taiwan has undergone considerable development over the past several decades and, in fact, has moved from being classified as a *developing or pre-industrialized* to a *developed or industrialized* society; (3) Taiwan

has crime statistics similar to the Uniform Crime Report (UCR) in the United States: annual official arrest data since 1958, broken down by specific age categories and types of offense.

By using the Taiwan crime data, in combination with U.S. crime data, the present study addresses three main research questions:

(1) Does the age-crime relationship vary across time?

Between 1961-1991, has Taiwan's age-crime curve shifted to a younger age distribution as predicted by the *variancy* position, or does Taiwan's age-crime curve remain essentially unchanged despite the forces of development, as predicted by the *invariancy position*?

(2) Does the age-crime relationship vary across societies?

Based on a comparison of Taiwan and U.S. crime data, is there significant variation between Taiwan's age-crime curves and the United States' age-crime curves during the same time period?

(3) What is the impact of development on the age-crime relationship?

Do markers of development predict changes (if they have occurred) in the age-crime distribution in Taiwan over the period of 1961-1991?

To examine these three research questions, this project first provides a background on prior age-crime theories and literature, along with a detailed introduction of Taiwan (see the rest of this chapter). Further, the study applies various descriptive and time-series methods to analyze the 1961-1991 Taiwan Arrest Statistics and 1940-1980 U.S. FBI Uniform Crime Report (see methodology in Chapter 2 and results in Chapter 3

and 4). It concludes with contributions of the present study, discussion of the findings, and implications for future research.

Background

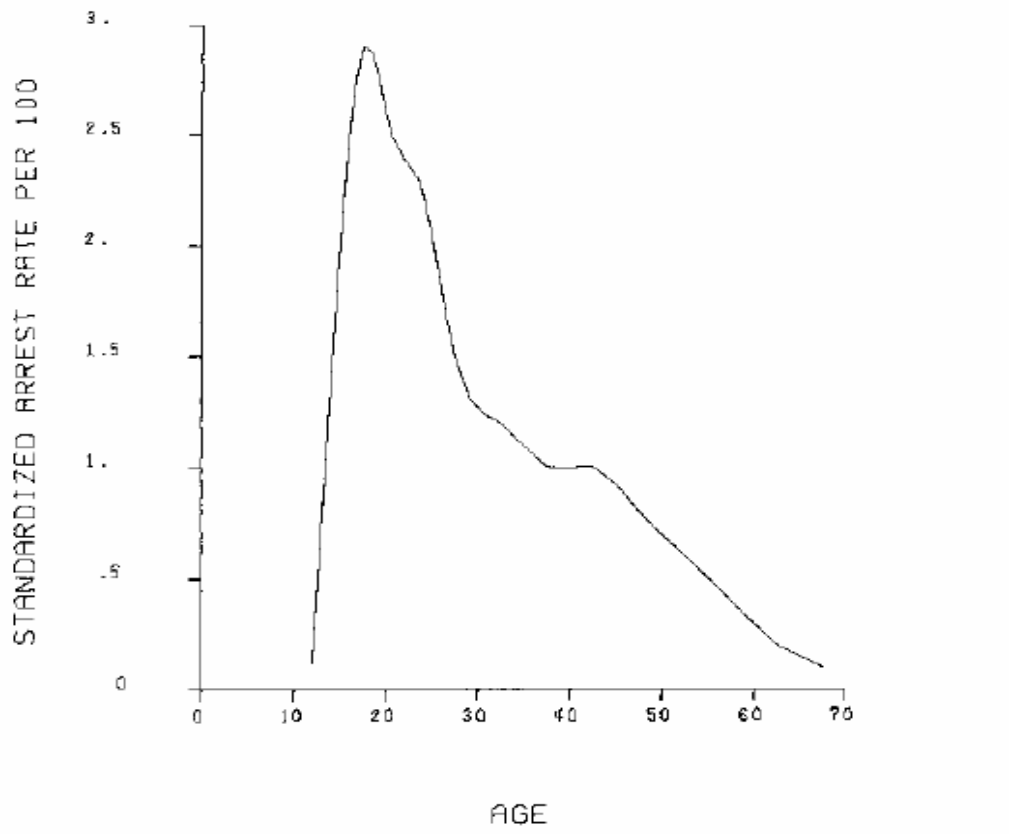
This section is a review of prior theory and literature on the age-crime relationship, focusing on the debate between the *invariancy* position and the *variancy* position. As I mentioned at the beginning of this chapter, the robust impact of age on criminal involvement is one of the oldest and most widely accepted findings in criminology. Scholars tend to agree that crime tends to rise/peak among youth and decline afterwards. There is contentious debate, however, on whether the above relationship between age and crime varies across all social and cultural conditions and all social groups at all times. Such debate leads to two competing views – the "Hirschi/Gottfredson view of invariancy" versus the "Traditional view of variancy". I examine both below in terms of their assumptions, theoretical explanations and empirical validity.

Invariancy Position

Assumptions. According to Hirschi and Gottfredson (1983), in every society, for all social groups, at all historical times, the tendency to commit all types of deviant behaviors rapidly increase in early adolescence, peaks in mid to late adolescence, rapidly decreases throughout 20s and 30s, and levels off during middle age. Figure 1.1 (Hirschi

and Gottfredson 1983: 558) presents the typical invariant age curve, an inverted "J". Hirschi and Gottfredson claim that the same pattern holds for both high-rate (or "delinquent") and low-rate (or "nondelinquent") groups; the curve has essentially the identical form for both groups (albeit at different absolute levels). Although they observe some minor variations around the invariant age curve, the basic shape of the curve is relatively stable (Hirschi and Gottfredson 1994).

Figure 1.1: The General Age-Crime Curve



Source: Hirschi and Gottfredson (1983: 558)

Explanations on the invariancy. Hirschi and Gottfredson do not give us any explanation for this universal age-crime relationship. Instead, they claim that there is no variable currently available in criminology that is able to explain it because a constant

(the age-crime curve) cannot be explained by a variable. The invariant age-crime curve must be explained by something that is constant across all societies and time periods. Some sociologists and criminologists have tried to provide such explanations (Gove 1985; Walsh 1995; Grogger 1998; Kanazawa and Still 2000). However, these explanations in fact only explain a part of the "universal" age-crime distribution. For instance, Kanazawa and Still (2000) offer a theory of evolutionary psychology to explain the age-crime curve: given that human society is always mildly polygamous, males tend to compete for women to reproduce. Such sexual competition increases men's probability of committing violent and property crime in every society, especially for young men. Once a man successfully reproduces, the cost of such competition increases and the benefits decline, which leads to dropping crime rates. Obviously, this theory is only able to explain male crime, while Hirschi and Gottfredson (1983)'s age-crime curve includes both males and females.

Empirical Validity. According to Akers (2000: 6), whether or not a criminological theory is acceptable should be judged by scientific criteria, such as internal logical consistency, scope and parsimony, empirical validity and usefulness, and policy implications. Among these criteria, the most important one is empirical validity, the extent to which a theory can be supported or rejected by research evidence. In general, the invariancy position has relatively poor empirical validity. First, although Hirschi and Gottfredson (1983) believe that the age-crime curve is invariant and holds in all human societies at all times, their empirical generalization is derived from a handful observations on contemporary developed western nations, without observations on Africa, Central America, South America (except for Argentina), or Asia (except for Japan).

Moreover, Greenberg (1985) criticized that Hirschi and Gottfredson's argument is based on problematic data, including errors in calculation and misinterpretation of historical studies. For example, Goring (1913) did not show the invariancy findings on the age-crime relationship that Hirschi and Gottfredson cited as important support for their argument. Finally, the constant explanations of the stable age-crime distribution that have been suggested are hardly empirically tested. For instance, if we want to test Kanazawa and Still's evolutionary theory (2000), it is almost impossible to operationalize the level of male competition for reproduction in one society.

Variancy Position

Assumptions. The traditional view of variancy in the age-crime distribution (represented by some earlier work such as Mannheim 1965, Greenberg 1977, and Sutherland and Cressey 1978 and elaborated by some recent pieces such as Greenberg 1985, Farrington 1986, Steffensmeier et al. 1989 and Tittle 1995) differs from the invariancy view of Hirschi and Gottfredson in two important ways. The first is that it argues that the familiar inverted J-curve association between age and crime (for most offenses and in modern western societies) can be explained by traditional social factors. The second difference is on empirical grounds—that, instead of invariancy, there are considerable variations in specific features of the age-crime relationship (i.e. peak age, median age, and rate of decline from peak age, etc.) across crime types, structural positions of groups and historical/cultural backgrounds. Although Hirschi and Gottfredson (1994) do recognize differences in details of the age-crime distribution, they

consider these differences to be "statistical noise", "trivial variations" or "an occasional factoid apparently contrary to the thesis". Objecting to their viewpoint, many scholars holding the variancy position believe that such variation, in fact, could be very substantial (even suggesting differences in the shape of the curve), especially when comparing different societies, historical periods and offense types[1] (Greenberg 1985; Steffensmeier et al. 1989; Tittle and Grasmick 1998).

Explanations of the first argument. In contrast with Hirschi and Gottfredson, many social scientists argue that traditional criminological theories and explanatory factors are able to explain the robust age-crime relationship (in modern western societies, the age-crime distributions peak in younger ages and decline rapidly with age). For example, Tittle (1995) contends that the causes of crime are the same at all age categories and the explanation of age effects, therefore, lies in variations in the magnitude of the causative variables by age. A variety of sociological theories, such as strain theory, opportunity theory, social control theory, differential association theory, rational choice theory, and cognitive theory, have been applied to explain the increased likelihood of youthful offending. Compared to adults, youth generally have limited access to legitimate means to meet their needs (Greenberg 1985); even in the underworld, they have fewer opportunities to commit low-risk and high-yield offenses (Steffensmeier et al. 1989). Also, they generally have weaker conventional social bonds and are less likely to be integrated into mainstream society (Rowe and Title 1977; Sampson and Laub 1993;

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[1] Scholars holding the variancy position also believe that there might be variations (but may not be very significant) across social groups, such as gender and race. The present study does not address these issues. Please see more details in Chapter 5.

Akers and Lee 1999). Further, the greater exposure to peer associations during adolescence reflects the increased sources of criminogenic reinforcement experienced by youth (Steffensmeier et al. 1989; Warr 1993; Akers and Lee 1999). Moreover, their dependent status as juveniles drives them away from many of the social and legal costs of deviant behaviors, while there are strong potential rewards for such behaviors, such as money, power, autonomy, identity, respect, and sensate experiences (Wilson and Herrenstein 1985; Steffensmeier et al. 1989). Finally, their stage of cognitive development limits prudence concerning the consequences of their behaviors (Gove 1985; Steffensmeier et al. 1989).

To explain the decline of crime in late adolescence, Steffensmeier and Ulmer (2002) summarize six important changes for teenagers when they reach adulthood: (1) more access to legitimate means to obtain material goods and excitement, such as jobs, credit, alcohol, and sex etc.; (2) more illegitimate opportunities for offenses that are less risky, more lucrative, or less likely to be reflected in official statistics, such as gambling, employee theft and fraud; (3) weaker orientation to same-age-sex peers and stronger orientations toward persons of the opposite sex or persons who are older or more mature; (4) adaptation of age-graded norms for adults: to internally reduce subjective acceptance of deviant roles and externally increase expectations of maturity and responsibility; (5) increased legal and social costs for deviant behavior; (6) improved cognitive and analytical skills which would lead to: less egocentrism, less hedonism, less sense of invincibility, more concern for others, more acceptance of social values, more comfort in social relations, more concern with the meaning of life and their place in things, and a greater possibility of seeing their previous deviance as childish or foolish.

Explanations of the second argument. Why is the age-crime relationship likely to vary across societies and over historical periods? Drawing from studies on the impact of development[2] on youth and their transition to adulthood, Steffensmeier and Ulmer (2002) summarize that youth's access to legitimate/illegitimate opportunities and their integration into adult society may vary across societies at different economic development stages. "Although youth has always been seen as a turbulent time, social processes associated with the coming of industrialization and the postindustrial age have aggravated the stresses of adolescence, resulting in increased levels of criminality in recent decades" (Steffensmeier and Ulmer 2002: 6). Therefore, the age-crime curves in industrialized countries tend to peak in youth and then drop off rapidly, while the peak age of crime is older and the drop off rates are much slower (flatter and less-skewed age-crime patterns) in less industrialized countries.

In pre-industrial societies, the formal "rites of passage" occur at relatively earlier ages and the family-based economies imbue youth with more responsibilities. Similarly, in the earlier historical periods of the United States and other industrialized nations, working-class youth were expected to leave school early to help their families, and farm children were crucial for harvesting crops. Youth in such societies, therefore, begin to assume responsible and productive roles well before they reach full physical maturity (Elder 1980).

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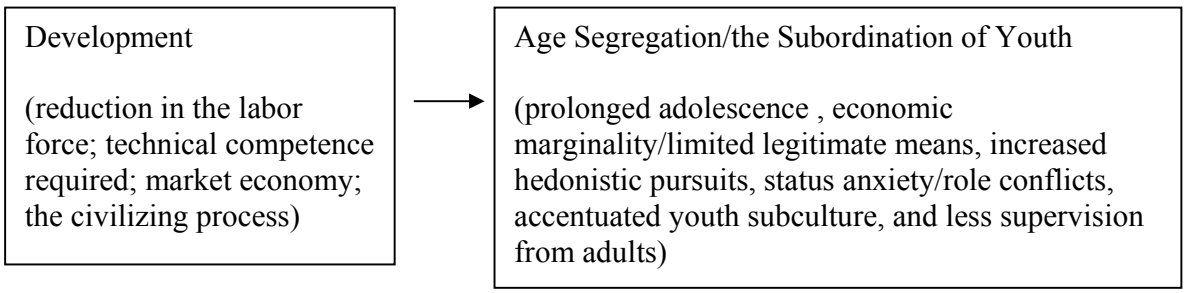
[2] More in-depth discussion on the possible relationship between development and age-crime distribution in Taiwan are provided in next section "Taiwan as a strategic research site". The measurement section of Chapter 2 defines the notion of development in detail.

In post-industrial societies, however, youth are more ambiguous concerning their social status and they are more isolated from the adult world (Larson, Wilson, Brown, Furstenberg and Verma 2003; Steffensmeier et al. 1989). Specifically, scholars argue that with economic development: (1) adolescence is prolonged due to the increased need for long-term education in a more complex society so that the uniform passage into adulthood is blurred; (2) the economic marginality of youth is increased since labor laws limit work for children, and because the developed labor force does not really need them (extra labor); (3) at the same time, due to the development of consumerism in societies, young people are encouraged to consume by mass education and media messages; (4) parents become more involved in work and thus have less time and opportunity to supervise their children. Compared to earlier eras, therefore, modern youth have less access to responsible family roles and valued economic activity. Instead, they have more role conflicts and hedonistic pursuits than their earlier peers. The status anxiety and limited legitimate means to obtain valued goods, along with accentuated youth subcultural influences (due to separation from adults), all combine to increase their possibility to commit crime.

Figure 1.2 characterizes the relationship between development and youth.

Figure 1.2 The Effects of Development on Youth



An important issue here concerns whether some cultural factors may mediate the effects of economic development on youth crime. Friday and Hage (1976) argue that youth crime is directly related to their meaningful kin, community, and educational/work relationships, although macro social change may influence the nature and quality of these institutions. In other words, culturally-relevant institutions may mediate the impact of development on youth crime. Messner and Rosenfeld (1997) also claim that economic institutions in industrialized societies are secondary to family institutions. With economic development, traditional families get disrupted and youth are emancipated from family duties, leaving youth more free time to deviate.

However, things may be different in Asian societies since they are often characterized by their strong family ties and close informal social control. Although they may experience similar economic growth as the Western world, their persistent and traditional values may dampen the adverse effects of development on youth crime. In the process of industrialization, although their age-crime curves could be more similar to industrialized Western nations, there is reason to believe that some cultural factors may reduce the degree of similarity.

Another important age-crime variance lies in age-crime differences across type of offense. Just as low-wage, dead-end jobs are disproportionately held by the young, so too are high-risk, low-yield crimes more common among the young. This so-called "age-stratification process", that youth are largely blocked from involvement in more lucrative crimes, is due to the lack of opportunities among youth, such as little experience, weak skills and low prestige etc. (Steffensmeier & Allan 1995). Therefore, the more lucrative, high-yield and low-risk crimes (e.g. loansharking, fencing, gambling, and "respectable crime") we study, the flatter the age curves (older age distribution and slower decline) we may observe[3]. It is thus important to examine age curves by offense types when exploring the age-crime relationship across time and place.

Empirical Validity. Systematic studies on the age-crime relationship have largely relied on data from the U.S. (Steffensmeier et al. 1989; Britt 1992; Greenberg 1994; O'Brien 1989; Tracy, Wolfgang, and Figlio 1990; Mokkonen 1999) or England (i.e. Farrington 1986). They found that compared to earlier eras, the modal crime age of youths in current industrialized societies is younger and the rate of decline from the mode is faster. Specifically, comparisons of UCR arrest statistics from 1940 to 1980, Steffensmeier et al. (1989; see also Britt 1992 and Greenberg 1994) find two important changes in the age distribution: in more recent time periods the peak age for crime has

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[3] Empirical studies have shown that the age-crime relationship is not exactly the same in all parameters across crime types. For example, in recent stidies of the United States (see Greenberg 1985; Steffensmeier et al. 1989), the median age of aggravated assaults and homicides is in the late twenties, while the median age of theft is in late adolescence. Moreover, in Title and Gramsmick's study (1998), very differently from other offenses, tax cheating, a form of white-collar crime, increases through middle age and declines thereafter, forming an upside-down U-shaped curve. My emphasis in this study is across societies and time periods. Variation across crime types is considered as a controlling factor. Therefore, I do not address this issue in the following text.

declined and the speed of the decline is more abrupt. Several age-period-cohort studies using data covering the 1940s-1970s also document that more recent birth cohorts of juveniles are more violent than previous ones (O'Brien 1989; Steffensmeier, Streifel, and Harer 1987; Tracy, Wolfgang, and Figlio 1990). Elsewhere, Mokkonen (1999) contrasted age-specific crime rates in New York City between 19th and 20th century to show that the maximum age for violence has become younger and more peaked over time.

No systematic research exists to explore the relationship between age and crime cross-culturally. Some analysts suggest that youth crime involvement and the model/median age of crime in certain countries (developing, Asian, African, Socialist) are significantly different from the United States (see review in Greenberg 1985; Friday 1980). For instance, Greenberg (1985) pointed out the fact that only 3% of all arrests in India were of persons under age 21 in the 1980s and both the modal and median age of homicides in Uganda was 35 between 1935 and 1955, which are significantly different from the United States. However, Greenberg lacks data to examine the age-crime distribution fully and longitudinally.

Although lacking a special interest in Eastern people and developing areas, cross-national criminologists have used age as an independent variable to predict crime among different countries (Hansmann and Quigley 1982; Ortega, Corzine, Burnett, and Poyer 1992; Gartner 1990; Messner 1989; Neapolitan 1994; Bennett 1991). On the assumption that the aggregate age-crime curve peaks in late adolescence or young adulthood and declines rapidly thereafter, these scholars hypothesized that the more young people a country has, the more crime it will experience. However, the studies produced inconsistent results after controlling for the proportion of young population in their

analytical models. Applying various measures (age categories are younger than 15, 15-19, 15-24, or 15-29, with some employing only males of these age groups and others including both genders), their findings range from positive relationship between the proportion of young population and national crime rates (Hansmann and Quigley 1982; Ortega et al. 1992), to nonsignificant (Gartner 1990; Messner 1989; Neapolitan 1994), and to negative (Bennett 1991). Also, due to the lack of crime data with detailed age information in developing countries, these studies are unable to directly compare the age-crime curves cross-culturally.

There is an abundance of speculation and some research supporting the view that development has apparently increased youth offending in the United States. Youth in recent decades experience more criminogenic stress through increased generational isolation and a youth culture oriented toward consumption and hedonistic pursuits (Hagan 1991; Wright, Cullen, Agnew, and Brezina 2001). Also, although today many teenagers are employed, they typically have marginal jobs that provide little self-respect or opportunities for adult mentorship, and instead expose them to the influence of a delinquent peer culture (Ploeger 1997; Steinbera and Caufman 1995).

At issue for our purposes is whether the trends in the Untied States and Western countries toward greater status anxiety, autonomy from parental authority, and more peer pressure, affect all youth globally. Cross-cultural research tends to show that with economic development, there is a slow convergence in the youth experience across the globe, although it is likely to vary in length and content both within and between countries/cultures (Arnett 2000; Brown, Larson and Sarswahi 2002). As Lagree (2004) reviewed, economic development will bring changes in family structure and institutions

like marriage, a more prolonged education to adapt to an information-based society, and a limited labor market for youth. All these factors will influence the context of the socialization of youth and may signal a radical transformation of cultures, morals, habits, and values. However, rather than resistance, anomie or detraditionalization, this process is a continuous reorganization and recompostion of tradition in modernity, especially through the family's power of adaptability (Brown et al. 2002; Bengston, Biblarz and Roberts 2002).

We turn next to a discussion of Taiwan as a strategic research site for addressing the contentious debate within criminology about whether the form of the age crime-relationship is invariant or variant across societies and time periods. In light of the gaps in research on the issue, there is a critical need for an examination of the age-crime relationship in non-Western or Asian countries that have experienced or undergone the full forces of industrialization and development.

Taiwan as a Strategic Research Site[4]

Taiwan is a mountainous island in the South China Sea, about 100 miles off the coast of southeastern China. Chinese people call this island Taiwan, meaning terraced bay. The wild, forested beauty of the island led Portuguese sailors in 1590 to name it Ilha Formosa, meaning beautiful island. Below is a map of Taiwan which is derived from the electronic World Encyclopedia (1999).

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[4] This Chapter is synthesized mainly from several literatures: Thornton and Lin (1994), Harrell and Huang (1994), World Encyclopedia Book (1999), Chu (2000), Rojek (2001) and Chin (2003).

Figure 1.3: The Map of Taiwan Area

As I introduced at the beginning of this chapter, Taiwan is a strategic research site to further address the debate about the age-crime relationship, especially when the age-crime curves are compared with those in the United States. Why is this the case? First, the population in Taiwan is largely composed of Chinese, and therefore Chinese culture is prevalent. Historically, Chinese culture is very traditional and Chinese societies have very low crime rates. Although Taiwan experienced an economic transition similar to the one experienced by the United States a century or so earlier, Taiwan's traditional culture may not have changed as extensively as American culture did. Second, like a natural experiment, Taiwan experienced unusually rapid social and economic changes in recent decades (after 1960) and quickly transitioned to a developed area in the early 1980s. This means that we can examine its age-crime relationship in both the pre-industrialization and

post-industrialization periods without having to document centuries of history. Finally, there are fairly good data in Taiwan to examine the age-crime relationship. Comparative studies are usually frustrated by the difficulty of getting good data. Very uniquely, Taiwan has continuing arrest reports since 1958, broken down by specific age categories and types of offense. Such detailed official crime data are only available in the United States and several other Western countries. All of these factors make Taiwan a valuable laboratory for addressing important unanswered questions concerning the relationship between age and crime.

The significance of Taiwan as a strategic research site for investigating the age-crime relationship is better realized, perhaps, when viewed in the context of its political and economic history that includes a major shift toward development and industrialization in recent decades. In contrast to what it was two to three decades ago, Taiwan today is in many respects a “modern society”.

Political History

Aborigines were the first inhabitants of Taiwan. Some Chinese came to the island from the mainland as early as the 500's, but large-scale migration did not begin until the 1600's. Dutch traders occupied Taiwan from 1624 until 1661. Koxinga (Cheng Ch’eng-Kung or Zheng Chenggong), a Chinese Ming dynasty official, drove them out. Manchu (Ch’ing or Qing) conquerors had overthrown the Ming dynasty in mainland China, and Koxinga wished to restore the Ming dynasty and planned to use Taiwan as a base to attack the Manchus. However, the Manchu dynasty conquered Taiwan and took it back

as part of China in 1683. In 1895, Japan gained control of Taiwan as a result of the first Chinese-Japanese War. China regained Taiwan after World War II ended in 1945. In 1949, the Chinese Communists defeated Chiang Kai-shek's (Jiang Jieshi) Nationalist (Kuomintang Party/KMT) forces and took control of the mainland. Chiang moved his government to Taiwan on Dec. 8, 1949.

After the Korean War began in 1950, the United States decided to protect Taiwan against possible attack from mainland China. It sent air and naval forces to patrol the Taiwan Strait (then called the Formosa Strait). The U.S. and the Chinese Nationalist government of Taiwan signed a mutual defense treaty in 1954. Besides continuing military support from the U.S., Taiwan received about $1.5 billion in U.S. economic and technical aid up to 1965. In the early 1970's, Taiwan expressed concern over improved relations between the United States and Communist China. In 1971, the United States announced it favored United Nations (UN) membership for Communist China. Although the United States insisted that Nationalist China (Taiwan)—a charter member of the UN—should retain its UN seat, in October 1971, the UN expelled the Nationalists and admitted Communist China. During the 1970's, a number of nations stopped their diplomatic relations with Taiwan and established ties with Communist China. The United States finally ended its diplomatic relations with Taiwan in 1978 and established diplomatic relations with Communist China in 1979. The mutual defense treaty between the U.S. and Taiwan was then withdrawn in the same year. But the United States promised to continue to provide Taiwan certain military aid. Also, the two agreed to carry on unofficial relations through nongovernmental agencies.

Chiang Kai-shek, who had served as President of Taiwan since 1945, died in 1975. Chiang's son Chiang Ching-kuo (Jiang Jingguo) took power in 1972. He was credited with launching most of the successful economic programs in Taiwan. After Chiang died in 1988, Vice President Lee Teng-hui (Li Denghui) became the new president. Also in the 1980's, the government began political reforms to increase democracy. In 1987, it ended martial law that had been in effect since 1949, indicating that the military would no long have legal and political power as before. Opposition parties were legalized in 1989, finishing the era of the Nationalist Party as the only legal political party in Taiwan. Multiparty elections were held in 1991 for the National Assembly and in 1992 for the Legislative Yuan. The Nationalist Party won a majority of seats in both elections. It thus remained in control of the government. In 1995 elections for the Legislative Yuan, the Nationalists won a slim majority. In 1996, for the first time, Taiwanese directly elected their president and Lee Teng-hui won the election. In 2000, Chen Shuibian, a politician from the Democratic Progressive Party (DPP), one of the opposition parties (for the first time, not Nationalist Party), was elected as the new President. He also won the most recent election in April 2004, although his victory is highly questioned by the public. Chen strongly argues that Taiwan is not a part of China but an independent country. This policy orientation now is opposed by both mainland China and the United States. The future of Taiwan is still unpredictable. Overall, the Republic of China on Taiwan (R.O.C.) now can be considered a democratic government.

Table 1.1 Political History in Taiwan

Year	Dynasty/State
Ca. 1523 B.C.- A.D. 1279	Chinese Empires (from Shang to Sung Dynasties)
1279-1368	Yuan Dynasty
1368-1644	Ming Dynasty
1624-1662	Dutch
1626-1642	Spaniards
1662-1683	Chengs (Ming loyalists)
1683-1895	Qing Dynasty
1895-1945	Japan
1945-present	Republic of China

Sources: Chu (2000: 201).

Military Draft of Youth

Facing the threat of war with mainland China, since 1959 Taiwan has stipulated that all male Taiwan citizens who are 19-years-old be drafted for two years service in the army, or three years service in the navy or air force. College students can fulfill this obligation after their graduation (around age 22). Therefore, the majority age group in the Taiwan military system is 19-24. For special cases (i.e. traveling abroad, physical problems or heavy family burden), this compulsory military service can be delayed or substituted by other types of service before they reach age 40, such as working in social welfare or the local police department.

Young males in the service are under strict supervision by superiors with strong Nationalistic patriotism, which may reduce considerable crimes committed by young adults. Also, since the Taiwan military system contains a relatively independent justice department, the offenses committed by soldiers are unlikely to be included in the official crime statistics. As long as this policy continues, the youth crime involvement in official crime reports is likely to be lower than in other developed societies, especially for ages 19-24.

With economic development and educational growth, there are more job opportunities for Taiwanes people. Also, due to the changed life styles (i.e. increased working couples and single families), the fertility rate decreases continuously. As a result, the non-adult (below age 18) proportion of the total population has dropped from 32.7% in 1989 to 27.3% in 1999. All these facts reduce not only the quantity of the Taiwan military manpower but also the willingness of individuals to serve in the military. Therefore, since 1999, the Taiwan government has shortened the service time to 22 months for all military branches. Based on the most recent military reform, in July 2005, the service time will become 18 months and the maximum service age will be 35 instead of 40. The Taiwan government plans that in 2008, recruiting volunteers can replace such conscription (Peng and Wan 2004).

Economic Development

Thornton and Lin described the process of Taiwan's economic development concisely in their 1994 book on Taiwan. During the precolonial period (before 1895),

Taiwan remained a closed, self-sufficient agriculture economy. Under the Japanese occupation from 1895 to 1945 (the colonial period), Taiwan's agriculture and industry expanded somewhat, including its transportation networks. World War II damaged the economy in Taiwan seriously, after which the 1949-1960 period mainly focused on recovery and the onset of some new policies. The policies initiated in the late 1950s paid off handsomely during the 1960s and Taiwan quickly transformed itself from a traditional agricultural economy into a labor-intensive export economy. Major economic growth in Taiwan occurred in the 1970s when annual rates of growth averaged 13.4%. During this period Taiwan began to be considered a developed region characterized by knowledge-intensive industries. Since the 1980s, economic growth rates have become stable at around 6.5%. The gross national product has continually expanded since the 1960s, and the economic conditions and wealth of residents in Taiwan have improved as well.

Various factors contributed to such great economic growth in Taiwan during the three decades. According to Wang and Ye (2004), the most important reason for the economic growth of Taiwan was the appropriate economic policy. These two scholars also summarized Taiwan's "economic miracle" from eight aspects, indicating why Taiwan's economic growth is so distinctive:

(1) Western countries usually need a long time to finish the transition from agricultural to industrialized societies (i.e. Britain took 200 years, the U.S. took around 100 years, and even Japan took about 60 years), while Taiwan spent less than 30 years on this process.

(2) Taiwan maintained a relatively low-level of inflation during rapid economic growth, which has never been seen before in the history of world economic development.

For example, from 1961 to 1972, the average inflation rate in Taiwan is 3.3%, almost equal to the industrialized countries' 3.5%; at the same time the average annual growth rate of Taiwan economy was 10.2%, more than double that of the industrialized countries' 4.6%.

(3) In its earlier development, Taiwan was highly dependent on the economic aid from the United States (from 1950-1965, around 100 million dollars per year). But after the U.S. stopped their aid in 1965, Taiwan realized its economic independency (with enough capital resources) quickly, due to its policy to encourage savings and investments.

(4) Taiwan's economy targets export trade (prior to the mid-1970s it was labor-intensive, while after mid-1970s it became knowledge-intensive), which overcomes the problems of limited local resources and a small market within the nation. In 1961, the export value in Taiwan was no more than 200 million dollars; such value increased 10 times (2.1 billion dollars) in 1971 and Taiwan exports exceeded imports for the first time; in 1981, Taiwan exports reached 22.6 billion (10 times that of 1971) and ranked number 16 in the world.

(5) Governments in other industrialized countries usually experience problems of deficit financing when trying to develop an economy, while in Taiwan, government financing has had surplus since early 1970s.

(6) Taiwan resolved its serious unemployment problem and created enough job opportunities. In the 1950s, the unemployment rate was 10% on average; in the 1970s, the rate dropped to 1.6%.

(7) The economic development of Taiwan made the society affluent rapidly. For instance, the average annual GNP per capita in the 1950s was no more than 100 US

dollars; in 1972, it became $522; in 1992, it exceeded $10,000; in 2000, it reached $14,188.

(8) Taiwan transformed from a society with high income inequality to a country with one of the most equal income distributions in the world. In 1950s, the difference between the highest-level and the lowest-level income was 15 times; in the 1960s, such difference dropped to 5.3 times; and in the 1980s, it became 4.2 times.

According to many scholars of modernization and development (see Harrell 1994: 166), "when societies move from a condition in which most people are subsistence agriculturalists, whose income derives from some kind of connection with particular parcels of property, to one in which most people are wage-earners in industrial or service occupations, certain transformations are inevitably going to happen, no matter what the nature of the previous social organization." Consistent with this argument, the above economic achievements in Taiwan are likely to have brought about substantial transformations in other social spheres, such as demographic transitions and even cultural changes. I elaborate on these transformations in the following sections.

People

In early in the 1950s, Taiwan was still an undeveloped island: 75% of the population were agriculturalists. Even in 1956 the largest city, Taiwpei, had a population of only 748,000 (DGBAS 1962). Currently, 70% of the population in Taiwan is urban; Taipei's population is about 5,000,000 (DGBAS 2003). Taiwan has become one of the most densely populated regions in the world. More than 20 million people live in Taiwan

and the population density is about 1,563 persons per sq. mi, compared to 310 persons per sq. mi in 1961 (DGBAS 1962 and 2003).

Although Taiwan life expectancy at birth has increased greatly (i.e. from 51 in 1949 to 74 in 1990), the annual rate of population growth has dropped from more than 3.5% in the early 1950s to around 1.0% in early 1990s (DGBAS 1962 and 1992). Such decline was partly a result of the successful implementation of a population policy that started in the early 1960s; it was also partly due to the economic development (See the section on "military draft of youth" for a brief explaination of why fertility rates decreased).

With an increased rate of investment in education to build up the human capital required to maximize economic growth, Taiwan experienced gradual development in education. In the 1950s, educational development focused on the expansion of primary education; in the 1960s, the national education requirement was extended from six to nine years; in the 1970s, the development of vocational education at the senior secondary level was the emphasis to technicians and skilled workers to enter the economy. Higher education has gotten more and more attention since 1980s (Sun 1994). In general, the average education level among the Taiwan population has grown greatly. For instance, in the beginning of the 1960s, the illiteracy rate(for ages above 12) for Taiwan was about 30%; in 1985, nearly everybody was educated (89% of those aged 12-17 were in school). As for higher education, in 1965, only 3% of employed people had received higher education; this increased to 15% in 1988 (DGBAS 1992).

Taiwan also has a high level of population homogeneity. Most Taiwanese are Chinese whose ancestors came to the island from Fujian (also spelled Fukien) and

Guangdong (Kwangtung) provinces on the mainland. Only about 2 percent of the population is made up of non-Chinese native peoples related to Indonesians and Filipinos. Most of the native peoples, sometimes called aborigines, live on reservations in the mountains. The Taiwan people speak various Chinese dialects, but almost all the people also use Northern Chinese (Mandarin), which is the official Chinese dialect. About half of the Taiwan people practice a local traditional religion that blends Buddhism, Confucianism, and Taoism. About 42% of the country's people are Buddhists, and about 8% are Christians.

Culture

Since the majority of the population is Chinese, Chinese culture is prevalent in Taiwan. Based on previous literature (Harrell and Huang 1994; Liu, Zhang, and Messner 2001), two cultural aspects—confucianism and familism/communitarianism—are key factors to explain low crime rates in Chinese societies, including the city-states of Hong Kong and Singapore, capitalist and Western-oriented Taiwan, and the state socialist-market reforming People's Republic of China (PRC).

Confucius (551-479 B.C.) was born at a time of social disorder and thus he developed a type of philosophy that seeks to restore order and harmony. The English philosopher Thomas Hobbes (1588-1679) also was born at a time of civil strife and had a need to set up social order and unity. It is interesting to compare their arguments and then look for the differences between Chinese and Western societies. Hobbes believed that the natural state of man was to have conflicts with one another (man was "solitary,

poor, nasty, brutish, and short"), and the only way to keep social harmony was by imposing it through a superior power. Hobbes's influence in Western civilization is quite pervasive and the need for the power of a sovereign to impose order is more or less taken for granted (Rojek 2001).

Instead of imposing order from without, Confucius sought to create order from within. According to Confucius, man is inner-directed, searching for humanity; human nature is perfectible and man can be led to virtue and righteousness. Chinese social organization thus stresses the cultivation of self, the striving for righteousness and virtue, and the suppression of natural desires for the betterment and harmony of the whole society. Filial piety (to respect, take care of and obey older generations) and loyalty are two very distinctive virtues emphasized in Chinese societies, which to a great extent, increases the likelihood of conforming to the expectations of social standards and laws. Such conformity helps to explain the low crime/deviance rates in Chinese societies (Huang 1994).

The role of Confucianism as the bedrock of high conformity in Chinese societies is reflected in the recent works of John Braithwaite (1989) and James Coleman (1988). In his 1989 book, Braithwaite provided Western societies an alternative model of social control: reintegrative shaming. Crime is best controlled in societies where there is a pervasive sense of familism and communitarinism. In those societies, the interest of the community or the group are placed above the interests of the individual; the community or the group has a willingness to accept a collective responsibility for the actions committed by the individual and a willingness to accept the offender back into the community.

Another popular sociological theory in recent years, social capital theory, also emphasized the effects of social support from families on crime control. Social capital refers to resources which facilitate action by virtue of individuals being socially integrated into solidary groups, networks, or organizations (Lin Nan 2001). For instance, with mutual trust and commitment, individuals living in integrated communities tend to have confidence that other unrelated adults will "keep an eye out" for their children (Coleman 1988).

Both of these theories emphasize that the more people are interconnected in social relationships and the more sense of obligation to the "community", the greater the potential for more effective social control. Such ideas, while they also exist in Western societies, are more strongly practiced in Chinese societies and have been for many generations. For example, Peng (2004) showed that the extended kinship network in China increases social solidarity, enforceable trust, and external bridges ties, through which the community could effectively monitor/protect clan members, exchange information/goods and cooperate with each other. Conflicts among clan members are usually resolved within the clan at very early stage. Moreover, Chinese people have strong family obligations. Chinese parents are prone to sacrifice everything for their children's well-being and regularly seek or exchange information about their children from other adults (i.e. teachers, relatives, and other children's parents). Children must show filial piety to their older generations, live with them, follow their orders, and provide both material and emotional support for them. Children are socialized to work hard for the benefit of their families and to protect the family's honor (Jang 2002; Whyte

1996). In other words, compared to Western nations, Chinese societies have more social capital and more effective informal community control to reduce crime and deviance.

The material changes in the modernizing process make possible the emergence of ideational/cultural changes. According to Long (2005), with development, the most significant cultural change in Taiwan is the rising of social-criticism and personal options. The respect to traditional authority and government drops greatly. More and more people have their own opinions on social events and tend to make life decisions by their own. Harrell (1994) pointed out another significant change in Taiwan—the weakening communitarinism. With urbanization and mobilization, people move out of traditional villages and tend to concentrate in urban areas, which is far away from their extended kinship networks. People in Taiwan thus focus more and more on their nuclear family ties and peer group ties.

However, familism (another important aspect of traditional Chinese culture) is apparently quite persistent in the force of the rapid social changes taking place. For instance, Thornton and Lin (1994) found that with social development, although there are some format changes in Taiwan's families (i.e. the decline of patrilocal residence and overt deference to elders, the rise in divorce, and the postponed marriage and first birth etc.), the key familial values are persistent. That is, marriage continues to be almost universal, parenthood is desired by nearly all, children receive extensive care from their parents, and the elderly obtain support from their children.

The Impact of Development on Taiwan Youth

In the process of modernization/development, children and youngsters are usually the ones profoundly affected by the changed family structure and organization of daily life. First, the rapid increase in per capita income has resulted in an affluent society in which young people, unlike their parents, have grown up in abundance and without much knowledge of scarcity. According to Chu (2000)'s discussion, different philosophies on life and leisure seeking have created a huge generation gap between contemporary parents and children in Taiwan. The new generation perceives that enjoying life is more important than working hard and saving money.

Second, the reduction of siblings make youth more self-centered. Through the 1950s and in the early 1960s, families usually had more than four children to share resources. While their material circumstances might been difficult, these children knew that there were other people in the world whose interest should be respected. They also learned to restrain themselves and to get along with other people. Currently, however, the average number of children in a family is about two, and for many families, these children are separated by several years of age. Thus each child grows up as if she or he were an only child. Such demographic changes may have occurred so rapidly that Taiwan people have not been able to adapt traditional forms of family education to this new situation (Sun 1994).

Third, the extended education, exclusion from the labor force, working parents/divorced families, weakened informal social network, and decreasing respect toward traditional authority may alienate youth from the adult world. The youth culture

and the autonomy of youth thus appear to rising (Sun 1994; Kahn 1979; Thornton and Lin 1994).

All these changes among Taiwan youth may increase their likelihood of committing crime. Some analyses suggest evidence that juvenile delinquency in Taiwan is on the rise, increasing faster than adult crimes, especially by the late 1980s (Chu 2000).

However, crime rates and especially juvenile delinquency rates in Taiwan are still much lower than crime rates in Western societies (Cao 1999). This might be due to the consistently strong familism existing in Taiwan society, since the emphases on family ethics and school education in Taiwan are usually considered as supportive factors of law-abiding attitudes and low delinquency involvement (Yuan 1993). As Harrell argued (1994:172), "education in Taiwan is still heavily Confucian, in that students are taught the Confucian virtues and the curriculum has a heavily moral content. In addition, debates about the correctness of everything from political opposition to sexual liberation are couched at least partially in the terminology of Chinese ethics. And there is also, even today, a bit of the idea of cultural superiority, of pride in China as the world's oldest and central civilization."

Therefore, although economic development in Taiwan may change the social context of young people and increase their likelihood of committing crime as occurred in western societies, such effects could be mitigated by the specific historical and cultural background of Taiwan. First, due to its history of colonization by Occidental and Oriental powers, a tightly-controlled structure has existed in Taiwan for a long time. Strict state control was especially enforced during the period of Japanese colonization and the Nationalist rule between 1949 and 1987. Such controlled social conditions may

be the key to understanding the relatively low and stable crime rates in Taiwan during this period (Chu 2000). Also, as I discussed in the military draft section, all 19-years-olds/college graduates in Taiwan should serve two years in the army or three years in the navy or air force. They may commit fewer offenses than the other age groups due to strict supervision; also, their offenses may not be reported to the official crime statistics. Finally, and most importantly, the central aspect of Chinese culture, familism, is still persistent in Taiwan society, which might reduce youth crime and deviance. Experts on China have addressed the capacity of this culture to absorb and accommodate various influences, while not allowing these influences to radically transform its society (Lagree 2004).

Expectations of This Study

This chapter began with a review of prior theory and literature on the age-crime relationship, emphasizing the debate between the *invariancy* position and the *variancy* positions. Next, I examined why Taiwan is a strategic research site for studying the age-crime relationship because of its political history, economy, population and culture. In contrast with the Hirschi and Gottfredson (1983)'s invariancy position, many scholars (see Steffensmeier et al. 1989) believe that there are considerable variations existing in specific features of the age-crime relationship across time and place. Specifically, with development, youth will become less integrated with the adult world. With more role strain, less legitimate means to satisfy their hedonistic pursuits, weakened supervision from adults, and increased youth culture, youth tends to be more criminogenic. Thus, the

age-crime distributions will be more concentrated among youth and peak at younger ages. Prior empirical studies in the United States and other Western societies have shown support for this variancy approach (Steffensmeier et al. 1989; Britt 1992; Greenberg 1994; O'Brien 1989; Tracy, Wolfgang, and Figlio 1990; Mokkonen 1999; Farrington 1986).

After exploring the socioeconomic background of Taiwan, we find that youth in Taiwan are also likely to be influenced by economic development and then become more involved in crime and delinquency. However, the traditional Chinese culture (esp. familism) may reduce the negative effects of development on youth crime involvement. The strict social control and the compulsory military service may also have certain effects on the Taiwan age-crime distribution.

Combining the arguments of the variancy perspective and the specific characteristics of Taiwan society, this study generates four specific hypotheses:

(1) Due to differences of the development level, the age-crime curve in Taiwan is not stable across different time periods, controlling for different offense types: the curve in the post-developed period will have a lower peak age and sharper declines thereafter, than in the pre-developed period;

(2) Due to the same reason, the general shape of the age-crime distributions in Taiwan may be similar to those in the United States at relatively equal development levels. Specifically, the age-crime distributions in both Taiwan and the US in the post-developed period will look like an inverted "J"; during the modernizing process, the direction of changes in the age-crime distribution for both societies is toward greater youth concentration in criminal offending and younger peak points.

(3) There should be certain differences when we compare the age-crime distributions in Taiwan with those in the United States, due to the cultural differences: Compared to the U.S., across all time periods, the population-adjusted percentage of youth arrested in Taiwan will be smaller, the peak age will be later, and drop off rates will be slower;

(4) It is the impact of development that drives the changes of the Taiwan age-crime distribution by increasing the youth offending involvement. Such effects on the age-crime relationship, however, may be mitigated by cultural forces.

Chapter 2

Data and Methods

This chapter describes the data sources and methods I used to examine the age-crime relationship in Taiwan. First, I introduce all the data sources applied in this study. Next, the detailed measures of dependent and independent variables are discussed. Finally, I explain the methods of analysis, including the descriptive techniques and time-series statistics.

Data Sources

The present study uses five data sources: Taiwan arrest statistics, Taiwan population figures, U.S. Uniform Crime Reports, U.S. population estimates, and data on key social and economic indicators of Taiwan. The yearly age-specific arrest statistics in Taiwan are available from Taiwan Crime and Analysis, published annually by the Taiwan Criminal Investigation Bureau of Police Administration Agency (CIB). To calculate crime rates and do further data analysis, the age-specific population numbers of Taiwan are taken from the Taiwan Yearly Household Registration Data, reported by the Taiwan Directorate General of the Budget, Accounting, and Statistics (DGBAS) in its major publication—Statistical Yearbook of the Republic of China. To estimate certain population numbers that are not available from DGBAS, the study resorts to several other demographic publications in Taiwan, such as the online Taiwan life tables and the

Taiwan Vital Statistical Abstract. The FBI in the United States publishes the Uniform Crime Report annually, which are comparable to Taiwan arrest statistics. The corresponding population numbers in the U.S. are available from the U.S. census bureau. To explore the effect of development on the Taiwan age-crime distribution, this study brings in a group of Taiwan socioeconomic indicators. Among these indicators, the Gini coefficient is from the world income inequality database, while all the others are reported by DGBAS in the statistical yearbook. I elaborate these data sources below.

Official Arrest Reports as Crime Counts in Taiwan

The crime counts used in this research are derived from the Taiwan arrest reports, published annually by the Taiwan Criminal Investigation Bureau of Police Administration Agency (CIB). These annual reports present data in tables showing the number of arrests in a given year, the offenses for which suspects have been arrested, and the age of the arrestees.

The statistics are available from 1958 to 2003, however, my analysis only focuses on the period of 1961-1991. As I noted in Chapter 1, the growth of Taiwan economy started in 1961 (Taiwan Year 50, also a census year). In 1992, the GNP per capita of Taiwan reached $10,000. After 1992, economic growth began to slow down. For the purposes of this study, it would be enough to use data from 1961 to 1992, the period experiencing the fastest economic development in Taiwan. Since 1992 (Taiwan Year 81) was not a census year in Taiwan, to easily get access to correct and detailed statistics, I chose 1991 (Taiwan Year 80, a census year too) as the end year for the analysis. Please

notice here that Taiwan applies its own calendar year, which is quite different from the calendar year in Western Societies. The Republic of China (another name for Taiwan) was built in 1911 (after Qing Dynasty) and thus 1911 became the first year of the Republic of China. After 1949, the government went to Taiwan and kept such a calendar. Translation between the two is simple: subtract 1911 from the Western year to determine the Taiwan year; or add 1911 to the Taiwan year to determine the Western year. As I mentioned above, 1961 is Taiwan Year 50, and 1991 is Taiwan Year 80.

There is controversy about the selection of data sets to study the age-crime relationship. Some scholars argue that only longitudinal self-report data can reflect the real age-crime relationship, while the others use official arrest records. I take the position that using official arrest records are more beneficial than using self-report data for several reasons. First, official arrest records are more consistent and usually cover longer time periods than self-report data. Second, official arrest records reflect the most serious criminal behaviors which are most harmful to society, and are comparable to the high-frequency measures in self-report data (Rowe and Tittle 1977). Third, analyzing five-waves of the National Youth Survey (a self-report study of delinquency) using growth curve analysis in the context of hierarchical linear modeling, Lauritsen (1998) found that using longitudinal self-report data to examine the age-crime curve is very problematic due to the noise from previous interviews and the lack of measures with high reliability/validity over time and age. Finally, the variancy/invariancy debate on the age-crime distribution actually has relied on official sources. For example, Hirschi and Gottfredson (1983) cited UCR arrest figures to support their invariancy position, whereas Steffensmeier and his colleagues (1989) found a fair amount of variance in their analysis

of the UCR arrest data. Therefore, it is reasonable to use Taiwan arrest data in this study to examine the age-crime relationship.

Nevertheless, it is important to keep in mind the limitations of official data that have been discussed extensively in previous literature (i.e. Biderman and Lynch 1991; Gove, Hughes, and Geerken 1985; Steffensmeier 1983). The main limitation of official crime statistics is that crimes might be underrecorded and/or underreported. For example, most males age 19-24 in Taiwan must serve in the military. During this period, their offenses are more likely to be missing in the official arrest data either because they are not recorded, or because they are handled in the military system instead of being reported to Taiwan police agencies (see Steffensmeier et al. 1980).

Another important limitation of the official crime statistics relevant to this study concerns changes in law and policing that might affect the volume of arrests over time. In Taiwan, first, the classification of offenses has changed; second, there have been changes in the definitions of age categories. Appendix A summarizes these age and offense changes by showing the specific age breakdowns and types of offenses covered in Taiwan arrest statistics over the 1961-1991 period. I highlight here the key changes in terms of offenses and age categories, and my approach to dealing with these changes.

Regarding the classification of offenses during the 1961-1991 period some categories were added, some dropped, and others subdivided or combined. My analysis of trends in the age-crime relationship in Taiwan, therefore, is limited to offenses that are collected continuously. These offenses include *homicide, aggravated assault, robbery, larceny, stolen property,* and *fraud*. There is also a summary measure on *total offenses*, including all types of offenses reported to the police. Based on the detailed offense types,

I created a *violence index* by combining homicide, aggravated assault, and robbery, as well as a *property index* combining larceny (including auto theft), stolen property, and fraud. The definitions of these offenses are all similar to those used in the United States.[5]

Before 1976, the age categories in Taiwan arrest statistics were broad and inconsistent. For instance, the age groups in 1961 were under 14, 14-17, 18-20, 21-30, 31-40, 41-50, 51-60, 61-70 and above 70, while the age groups in 1974 were under 12, 12-17, 18-19, 20-29, 30-39, 40-49, 50-59, 60-69 and 70 and above. Since 1976, CIB began to use the individual-age breakdown for ages through 10-29 and ten-year groups for all the other ages. To compare the age-crime distributions among different years, my analysis mainly follows the age categories in 1961 and all the latter years are adjusted to match. I elaborate on the methods to deal with these age data in the analysis section.

Population Numbers in Taiwan

In order to adjust for differences in population composition over time and across age groupings, the present study calculates age-specific arrest rates based on the arrest counts provided by Taiwan Crime and Analysis (CID 1961-1991) and on the population figures provided by Taiwan Statistical Year Book (DGBAS 1961-1991). The procedures used to calculate the age-specific rates vary somewhat depending on the nature of the analysis at hand.

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[5] Since 1976, Taiwan arrest reports separate forceful taking from robbery. To be consistent over time, I combine robbery and forceful taking for these years. Moreover, please keep in mind that in Taiwan, larceny includes both general theft and auto theft. For earlier years, larceny also contained burglary.

In the first part of the analysis, I compare the age-crime distributions for the years 1961, 1976, and 1991. The Taiwan Statistical Yearbook reports the individual-age population numbers for four years between 1976 and 1991[6], but does not report these numbers for 1961. I therefore use figures from Taiwan life tables (see Department of Statistics 1926-2003) and yearly birth registration numbers (see Department of Health 1966) to generate the individual-age population numbers in 1961. Since the life table is sex-specific, the final calculation for the total age group needs to add males and females together. For example, if the male birth population in 1947 is 124,056 and the male survivorship to age 14 in the life table of that year is 72,383 per 100,000, the male population size of age 14 in 1961 should be about 89,795 (=124,056 X 0.72383). Similarly, the number of females at age 14 in 1961 is about 86,309 and thus the total population of age 14 in 1961 is 176,104 (the sum of male and female estimates). Demographers often use such methods to estimate the population numbers for specific ages (Schoen 1988). I elaborate on these techniques in the data analysis section.

In the second part of the analysis, using data from all the years, I run time-series models to examine trends and to explore the social and economic factors shaping the trends if the trends are significant. My focus is on ages 12-17 (juveniles) versus ages 18-49 (active adults), the two most consistent age groups reported in Taiwan Arrest Reports over time. Unfortunately, Taiwan Yearly Household Registration Data only reports population numbers for 5-year age intervals. I calculate the yearly population numbers

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[6] Taiwan Statistical Year Book 2003 began to report the single-age population numbers. The reported years include 1974 (TW Year 63), 1976 (TW Year 65), 1981 (TW Year 70), 1986 (TW Year 75), 1991 (TW Year 80), 1994 (TW Year 83) and each year after 1994.

for juveniles and adults based on relevant statistics in the Taiwan Statistical Yearbook. To calculate the adult population numbers from 1961 to 1991, I use the available education statistics in the year book that provide third-level (age 18-24) student numbers and third-level enrollment rates. In this way, I am able to estimate the population numbers for age 18-24 (population=number of students/enrollment rates). Ages 25 and above are directly available in the Taiwan Yearly Household Registration Data. Adding the population numbers of 18-24 and 25-49, we arrive at the active adult population figures. Similarly, I am able to calculate the population numbers for ages 12-17 using the second-level education statistics from 1961-1991.

The Arrest Statistics and Population Figures in the United States

To compare the age-crime distributions of Taiwan with those in the United States, I also draw age-crime curves based on the 1980 Uniform Crime Report and the 1980 census in the U.S. The UCR arrest statistics by age and type of offense have been published annually by FBI since the mid-1930s. As an official source of information in reported crime, the UCR shares similar limitations with Taiwan arrest statistics (see details in Steffensmeier and Cobb 1981; Steffensmeier 1983; Gove et al. 1985; Biderman and Lynch 1991).

The UCR program contains a detailed classification (about thirty types) of offenses. To simplify the comparison between Taiwan and the United States, I only draw curves for violent crime index, property crime index, and total offenses based on the UCR data. The age categories in the 1980 UCR were 10-12, 13-14, single-year groups

for ages 15-24, and five-year groups for the remaining ages. The population numbers with individual-age breakdown used to calculate the crime rates are available from the U.S. census bureau.

Social & Economic Indicators in Taiwan

To explore the impact of development on Taiwan age-crime distributions, a series of economic and social indicators of Taiwan are used to generate measures of development and relevant controls. Specifically, the indicators include the human development index, gross domestic product (GDP) per capita, Gini coefficient, economic growth rate, proportion urban population, divorce rate, proportion of the population that is juvenile, and the police clearance rate. All the variables are obtained from the Taiwan Statistical Yearbook, except the Gini coefficient which is from World Income Inequality Database (UN 2004). These measures are spelled out below.

Measures of Dependent Variables

Three types of computations will be performed on the arrest tabulations. The first one is age-specific arrest rates[7] that adjust for appropriate population numbers for

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[7] Another controversy in the age-crime field is the confusion between criminality and criminal behavior. At the beginning of Hirschi and Gottfredson's article in 1983, they use crime rates as the dependent variable, while in the middle of that paper they shift to criminality (tendency to commit crime). The following studies to test and explain this invariant age-crime relationship are very inconsistent about whether criminality or criminal behavior should be used. I believe criminal behavior is more meaningful than criminality in this area. First, according to Hirschi and Gottfredson themselves, criminality refers to the propensity to commit crime and is highly related to low self control, which is itself stable over the life

each year. The numerator will be the number counts for a specific age group, while the denominator will be the population size of the age group in the same year. The results will be multiplied by 100,000 to present crime rates per 100, 000 population. The following two measures on crime are both on the basis of arrest rates.

The second type of calculation (for descriptive analysis) is the age-specific percentage involvement (PAI), defined as the proportion of crime committed by that age group adjusting for age composition in the population (Steffensmeier et al. 1989). The PAI (see the formula in the following section of statistical analysis) is derived from the age-specific rates and measures the timing of crime across the life span. For example, when I compare the age-crime curves in different years, to calculate the PAI of 14-17, the arrest rate of 14-17 would be divided by the sum of the arrest rates of all age groups (rate of under 14+rate of 14-17+rate of 18-20+rate of 21-30+…+rate of above 71) and then multiplied by 100%. The benefit of using PAI is that it controls for variation in age composition of the population over time. Thus, the age-crime curves based on PAI are comparable among different years. In other words, they are standardized.

As I discussed earlier, juveniles (age 12-17) and adults (age 18-49) are more consistently coded than any other age categories in Taiwan arrest reports. Therefore, the third type of calculation (for time-series analysis) is the natural log ratio of $Rate_{12\text{-}17}$ relevant to $Rate_{18\text{-}49}$, only involving two age groups. On one hand, the natural log

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span (See pp. 134-137 of General Theory of Crime). So crime (short-term, circumscribed events, in their words) does decline with age, whereas criminality doesn't (indicating that the age-crime curves do not exist). Also, a theory of criminality and intraindividual differences in it is very difficult to be empirically tested. Most studies on criminality in fact still choose behaviors as dependent variables, which make their arguments ironic.

controls better for random fluctuations and outliers; on the other hand, since this is a symmetrical measure of the age gap (except for the sign), testing youth-to-adult arrest rates is equal to testing the adult-to-youth arrest rates. Using this logarithmically transformed measure as the dependent variable also induces homoscedasticity in a regression model (see O'Brien 1999 for a cogent review of this method).

Measurement of Development

In the second part of the data analysis, I employ time-series regression models to examine whether development increases the youth concentration of crime in Taiwan. The independent and control variables chosen are based on theoretical grounds and prior research, plus a check on the multicollinearity among these variables.

Although few studies have tested the relationship between development and the age-crime distribution, there is abundant research exploring the effects of development on general crime. This category of research has one of the longest traditions in criminological literature. This large body of literature includes both descriptive and analytic studies (i.e. Friday and Hage 1976; Ortega et al. 1992), both qualitative and quantitative studies (i.e. LaFree and Kick 1986; Krohn and Wellford 1977), both national and multinational samples (i.e. Liu and Messner 2001; Neapolitan 1995), and both cross-sectional and longitudinal designs (i.e. Steffensmeier, Allan and Streifel 1989; Bennett 1991).

It is generally assumed that development is accompanied by a decrease in social problems (Ritzer 2004). However, the relationship between development and crime has

not been clearly established. Some studies show that the relationship between development and crime is weak or nonexistent (Pratt and Godsey 2002; Neuman and Berger 1988). Other studies find that development has differing effects on violent and property crime. Several articles argue that development tends to decrease violent crime and increase property offending (Lee 2001; Messner 1997; Neapolitan 1995; Kick and LaFree 1985; Krohn 1978). Still others (e.g. Ortega et al. 1992) conclude that the effect of development is in the same direction and is about the same size for both theft and homicide.

These inconsistent findings are due, in part, to different measures of development. Development has been approached in two ways. The traditional approach defines development largely in terms of economic level and measures it using the GNP per capita (Krohn and Wellford 1977; Ortega et al. 1992) or the GDP per capita (Messner 1982; Bennett 1991). GNP per capita (also called FX method) is the gross national product divided by a nation, evaluated in dollars at current contemporary exchange rates. GDP per capita (also called PPP method) is the gross domestic produce divided by a nation, evaluated in dollars at purchasing power parities. Although the quantitative difference between GDP and GNP for a given country is usually minor (less than 10%), Firebaugh (1999) came down firmly on the side of the GDP/PPP methodology, arguing that: "though early studies in economics used FX estimates because PPP estimates were unavailable, PPP-based income is now the industry standard…FX rates are highly flawed calibrators of currencies for two reasons. First, many goods and services are not traded on the international market, so exchange rates are based on a restricted bundle of goods and services…Second, FX measures are not totally "free" but are routinely distorted by

government policy and speculative capital movement. ” (pp. 1604, 1609) Therefore, the present study uses *GDP per capita* as the main measure of the level of development in Taiwan. It is available for all the years during the period of 1961-1991.

The most recent approach is to view development as multidimensional. According to Barak (2000), development refers to modern institutions, secularized values, industrialization, urbanization, rapid economic growth, and dissolution of the traditional or repressive social orders. That is, only using GDP per capita or other economic statistics are not enough to measure development. Since 1990, the United Nations Development Programme (UNDP) began to publish the *Human Development Index (HDI)* for many nations annually, aiming to reflect the level of development more comprehensively. The HDI is a composite index of three basic dimensions of human development in one country: “a long and healthy life, as measured by life expectancy at birth; knowledge, as measured by the adult literacy rate (with two-thirds weight) and the combined primary, secondary and tertiary gross enrolment ratio (with one-third weight); a decent standard of living, as measured by GDP per capita (PPP US$)” (Human Development Report 2003: 341). Specifically, the formula is

Life Expectancy Index= (Life Expectancy-25)/(85-25)

Education Index=2/3 (Adult Literacy Rate)+1/3(Gross Enrolment Ratio)

GDP Index=[log (GDP per capita)-log (100)]/[log(40000)-log(100)]

HDI=1/3 (life expectancy index) + 1/3(education index) + 1/3(GDP index)

This index is considered by some researchers to provide an adequate summary of indicators of development at the aggregate level (Dasgupta and Weale 1992). Criminologists have used HDI to predict the effects of development on crime (e.g. Pratt

and Godsey 2002). Therefore, I select HDI as an alternative measure of the level of development in Taiwan. That is, all regression models are tested first with GDP per capita and then with the HDI. Since the UN does not recognize Taiwan as a country, the human development report did not include HDI scores for Taiwan. But I can calculate it by utilizing relevant data provided in the Taiwan Statistical Yearbook 1961-1991.

Measures of Control Variables

I use the following variables as controls in my multivariate analysis: rate of economic growth, Gini index, unemployment rate, proportion of the population that is urban, divorce rate, proportion of the population that is young, and police clearance rate. These variables are typically employed by researchers when conducing aggregate-level analyses of crime (for review, see LaFree and Kick 1986; Neuman and Berger 1988; Pratt and Cullen 2005).

First, I use *rate of growth* to evaluate the speed of development (also called relative development). Based on Durkheim (1933), development itself is not necessarily prone to anomie. Social change becomes problematic only when it is unusually rapid, which would lead to anomie. Derived from a longitudinal study for 52 nations, Bennett (1991) also found that the rate of increase in crime is proportional to the rate of economic growth. This study defines *rate of growth* as the yearly differences of GDP per capita. The formula is

$$\text{Rate of Growth} = 100 \times (GDP_{t1} - GDP_{t2})/GDP_{t1}$$

where t1 refers to an earlier year (e.g. 1961) and t2 refers to a later year (e.g. 1962).

Second, I include two measures of inequality—the commonly used Gini index of inequality and the unemployment rate to reflect changes in Taiwan economic well-being and relative deprivation. According to McDonald (1976), "inequalities in power, economic or political, were ultimately responsible for the nature of the criminal law established, its enforcement, and the pattern of criminal behavior appearing." (pp 22). The Gini index is the most highly regarded and best known measure of national income inequality, defined as the ratio of the sum of the mean income differences to twice the arithmetic mean (Atkinson 1983). It varies from 0 to 100, where 0 corresponds with perfect equality (where everyone has the same income) and 100 corresponds with perfect inequality (where one person has all the income, and everyone else has zero income). This inequality measure may be unreliable in cross-national settings since many countries have Gini observations based on mixed definitions and sources that need to be accounted for (Messner 1989; Moran 2003). However, this comparability problem has little effects on studies examining inequality within one nation. The present research thus is able to use this index to measure economic inequality in Taiwan.

As for *the unemployment rate*, on one hand, it indicates the level of blocked legitimate means to economic success (Neapolitan 1995); on the other hand, it also implies the level of crime opportunities and social control, such as increased motivated offenders and decreased efficiency of the criminal justice system during economic recessions (D'Alessio and Stolzenberg 1995). The World Income Inequality Database (UN 2004) has reported Taiwan Gini Index (Person Equivalence) annually since 1964. The Taiwan Statistical Yearbook began to report the unemployment rate (age 15 and above) also since 1964.

Third, I control for three variables that are commonly-used as controls in prior aggregate-level research: *percent of juvenile population (ages 12-17)*, *family disruption* and *urbanity*. All of these could be considered as indicators of changes in social control and opportunities for crime (see reviews in Pratt and Cullen 2005) . I measure family disruption using the divorce rate, while I choose the percent of the population that is urban as the measure of urbanity. All these variables are obtained from the Taiwan Statistical Yearbook (GDBAS 1961-1991).

Finally, since official crime statistics are highly associated with the performance of the police department, to reduce the yearly bias from police, criminologists tend to include some measures on police force or the criminal justice system as controls (McDonald 1976; Neapolitan 1999). This study uses the yearly police case clearance rate in Taiwan as a control variable. Taiwan Statistical Yearbook started reporting this measure in 1962.

All dependent, independent and control variables are summarized in Table 2.1.

Table 2.1 Conceptualization and Operationalization of Variables in the Regression Model

Variable Name	Conceptualization	Operationalization
Dependent Variable		
Youth-to-Adult Crime Gap	The relative difference between youth crime involvement and adult crime involvement	Log Ratio of Youth (12-17) Crime Rates versus Adult (18 and above) Crime Rates
Independent Variables		
Level of Development		

-GDP per capita	A traditional measure of economic development, using the income data based on domestic purchasing power parity	National gross produce divided by the population of that nation
--Human Development Index	A general measure of the absolute level of development, combining longevity, education and economic status in one society	The sum of weighted life expectancy at birth, the adult literacy rate, the combined gross school enrolment ratio, and GDP per capita (PPP US$). The final value of HDI varies from 0 to 1. The higher the value, the more developed the society.
Control Variables		
--GDP per capita growth rate	One measure on the relative level of development: how fast the economy grows	The growth ratio between the current year GDP per capita and the previous year GDP per capita
--Gini Index	A traditional measure of income distribution in one society, representing most of the population	The Gini index varies from 0 to 100, where 0 corresponds with perfect equality (where everyone has the same income) and 100 corresponds with perfect inequality (where one person has all the income, and everyone else has zero income).
--Unemployment Rate	One measure of economic stress (also of social control and opportunities): the extent of the society blocking persons' legitimate means to success	The percentage of unemployed persons among the total population aged 15 and older
--% Urban Population	One indicator of urbanization (important social change with development)	The proportion of persons living in urban areas
--Divorce Rate	The level of divorce in one society, an important measure on family disruption.	The number of divorces per 1000 population
% Young Population	The proportion of the population that is most at risk of offending in one society	The percentage of ages 12-17 among the total population
Clearance Rate	The efficiency of the police department to solve the known cases, a traditional measure of police performance	The percentage of solved cases among the total known cases

Statistical Analysis

Descriptive Techniques: to Compare/Contrast Age-Crime Curves in 1961, 1976 and 1991

The first part of the analysis (Chapter 3) is descriptive. I will plot age-crime curves in Taiwan and the United States across time[8] and type of offense, using PAI as the indicator of age-specific offending. To avoid drawing too many plots, I select three time points: 1961, 1976, and 1991. As I mentioned before, 1961 is the starting point of the lift off of Taiwan's economy, and 1961 is also an important statistical year in Taiwan (TW Year 50). 1991 (TW Year 80) was another important statistical year because it is 30 years after TW50. Between 1961 and 1991, 1976 was a convenient middle point. To add stability to the crime figures, I use the average of the arrest numbers by offense types for the years 1961-62, 1976-77, and 1991-92. These curves are easily understandable and provide a straightforward assessment of the relationship between age and crime.

The definition of age groups in Taiwan arrest data changed some from 1961 to 1991 (see Appendix A). Table 2.2 lists the specific age breakdowns for Taiwan arrest statistics in the years 1961, 1976 and 1991:

Table 2.2 Age Breakdown for Taiwan Arrest Statistics, 1961, 1976, and 1991

Year	Age Breakdown
1961	<14, 14-17, 18-20, 21-30, 31-40, 41-50, 51-60, 61-70 and 71+
1976	<10, each age from 10 to 29, 30-39, 40-49, 50-59, 60-69 and 70+
1991	<10, each age from 10 to 29, 30-39, 40-49, 50-59, 60-69 and 70+

[8] For the age-crime distributions in the United States, I only show plots for year 1980. 1940 and 1960 age-crime curves are analyzed tabularly based on Steffensmeier et al's study in 1989.

This table shows that the age breakdown in 1961 is different from the age breakdown in 1976 and 1991. To compare the age-crime distribution among these three years, I draw the plots based on the broad age categories used in 1961 and make appropriate adjustments for the data in 1976 and 1991.

The calculation of population-adjusted arrest rates and then PAI for the years 1976 and 1991 is straightforward inasmuch as individual-age population numbers are available for these two years (DGBAS 2003). However, for 1961, the population numbers are provided only in 5-year age groups. Moreover, these 5-year age groups do not correspond in some cases with the age categories in the 1961 arrest data. Based on 1941-1947 birth registration numbers and the life table for that period, this research calculates the number of persons for age 14, 18, 19, and 20 in 1961[9]. With these numbers, adjustments can be made for the first three age groups (<14, 14-17, and 18-20) in 1961 arrest counts. Since the population numbers for 20-29, 30-39, …, 60-69 and 70+ are very

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[9] The first function in the life table is $l(x)$, representing the number of persons in the life table cohort surviving to exact age (x). The initial number of persons in the life table cohort, $l(0)$, is conventionally set equal to 100, 000. Based on this function, we can calculate the single-age population numbers if we know the size of the cohort (birth numbers in that year) and the corresponding life table of that cohort. For instance, persons age 18 in 1961 belongs to the birth cohort of 1943. Derived from Taiwan Vital Statistical Abstract, the male birth number in 1943 was 135,399 and female birth number was 125264. In 1936-1946 Taiwan Life Table (only the period life table available), $l(18)$ for male is 71272 , meaning that per 100, 000 population of this cohort, 71272 persons would live to the instant of attaining age 18. The total number of male survivors in 1961 (age 18) was 96502 (=135399* 71272 /100000). Similarly, the number of female survivors in 1961 was 91078. The sum of male and female survivors, 187580, could be considered the population number of age 18 in 1961.

Since only the period life table (1936-1946) is available, the survivorship for age 14, 18, 19, and 20 may have some errors. I made a further adjustment to correct this problem. Using this life table method, I calculated the single-age numbers for age 10-14. Then I compare the sum of 10-14 to the actual population counts for this age group reported in 1961 Taiwan Household Registration Data. The ratio of them is about 1.2, indicating that the life table might underestimate the survivors for age 10-14. Therefore, the number of age 14 derived from the life table method should be multiplied by 1.2 to represent a more accurate estimation. Following the same procedure, I find that the life table method might overestimate the number of age 18, 19 and 20. The adjustment ratio is about 0.9. In other words, the number of age 18 in 1961 should be 168822 (=187580*0.9).

similar to the groups 21-30, 31-40, …, 61-70 and 71+, they can directly be utilized as the population denominators when calculating crime rates for age groups 21-30, 31-40, …, 61-70 and 71+. It will have little effects on the results[10]. Similarly, in 1976 and 1991, the crime rates for age groups 20-29, 30-39… 60-69 and 70+ can be considered approximate to the crime rates for age groups 21-30, 31-40, …, 61-70 and 71+.

Specifically, the present study calculates the age-specific crime rates in 1961 as below:

$$r_{10-13} = 100000 * \frac{A_{<14}}{P_{10-14} - P_{14}}$$ [11]

$$r_{14-17} = 100000 * \frac{A_{14-17}}{P_{15-19} - P_{18} - P_{19} + P_{14}}$$

$$r_{18-20} = 100000 * \frac{A_{18-20}}{P_{18} + P_{19} + P_{20}}$$

$$r_{21-30} = 100000 * \frac{A_{21-30}}{P_{20-24} + P_{25-29}}$$

…

As for the years 1976 and 1991, their crime rates are

$$r_{10-13} = 100000 * \frac{A_{10} + A_{11} + A_{12} + A_{13}}{P_{10} + P_{11} + P_{12} + P_{13}}$$

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[10] For example, the total population number of 30-39 in 1976 is 1816445, while the total number of 31-40 in the same year is 1809335. The total arrest number for 30-39 in 1976 is 8311. The arrest rate using population 30-39 is 457.54, whereas the arrest rate using population 31-40 is 459.34.The difference of the two is only 0.996 (=457.54/459.34).

[11] Since children under 10 commit very few offenses, the population base for arrest age <14 can be population numbers from 10 to 13. Similarly, the population base for arrest age 71+ could be age 70+. It makes little difference.

$$r_{14-17} = 100000 * \frac{A_{14} + A_{15} + A_{16} + A_{17}}{P_{14} + P_{15} + P_{16} + P_{17}}$$

$$r_{18-20} = 100000 * \frac{A_{18} + A_{19} + A_{20}}{P_{18} + P_{19} + P_{20}}$$

$$r_{21-30} = 100000 * \frac{A_{20} + A_{21} + ... + A_{29}}{P_{20-24} + P_{25-29}}$$

…

where r=age-specific arrest rate, A=the average of age-specific arrest numbers for the two years (1961-62, 1976-77, and 1991-92), and P=age-specific population numbers.

With the above crime rates, I then calculated the PAI:

$$PAI_{ij} = 100 * \frac{r_{ij}}{\sum r_{ij}}$$

Where r=age-specific arrest rate, i=age category (10-13, 14-17, 18-20, 21-30, …, 61-70, and 71+), and j=type of offense (total, violent, property, homicide, aggravated assault, robbery, larceny and auto theft, stolen property, and fraud).

This research also examines youth share of crime involvement using more specific age breakdowns for ages 10 through 29 in 1976 and 1991, since the crime reports for 1976 and 1991 contain information on single-year groups for ages 10-29 (and ten-year groups for the remaining ages). The denominator of PAI then becomes the sum of r10, r11, r12… r29, r30-39, r40-49…and r70+.

Based on PAI, this study uses various measures to characterize the age-crime distributions and their changes over time. These measures include peak age, PAI at peak, skewness and kurtosis. Skewness measures the degree to which a distribution is skewed

or symmetrical. Kurtosis measures the extent to which a distribution is flattened or peaked around its center.

The present research also applies one traditional test to explore the homogeneity of two different distributions: the index of dissimilarity (D). *D* is calculated on the basis of PAI, indicating the percentage of arrests that would need to be redistributed among age groups in order to achieve perfect congruence between the age curves of the same offense type for two different time periods (in this study: 1961/1976, 1976/1991, and 1960/1991). The formula is:

$$D = \frac{1}{2}\sum \left| o_{ijt1} - o_{ijt2} \right|$$

Where o_{ijt1} is the percentage of arrests for age group *i* for offense *j* at time point 1, and o_{ijt2} refers to the percentage of arrests for age group *i* for offense *j* at time point 2. Following Steffensmeier et al.'s study in 1989, if these two distributions are significantly different, the *D* value should be 15 or greater.

Similar methods are applied for the analysis of the age-crime distributions in the United States. The calculations of crime rates and PAI in the U.S. are straightforward, since the individual-age population numbers are available from the U.S. census bureau.

Time-Series Methodology: Dickey-Fuller Test & Annual Time-Series Regression Model for Trends of Youth Share of Crime Involvement, 1966-1991[12]

As I discussed in Chapter 1, criminologists holding the variancy position tend to believe that development is likely to increase youth share of crime involvement. Is that true? Using the logged measure on relative differences between youth and adult crime involvement for each year between 1966 and 1991, this research employs augmented Dickey-Fuller Tests to see whether the youth share of arrests is moving in tandem with adult rates, trending upward (at a greater pace than adults), downward (slower pace than adults), or not trending at all. Since the data series in this study is about 30 years, picking three time points to examine the age-crime relationship may be arbitrary and ignore a large amount of available data. Moreover, although descriptive studies provide direct insights into the youth-to-adult trends of crime rates, they have many limitations. The augmented dickey-fuller test is well-suited to examine whether there are systematic year-to-year changes in the share of youth offending by accounting for random fluctuations, isolating "shocks", and solving autocorrelations (see O'Brien 1999 and Liu & Messner 2001).

It is well known in the time series literature that the first-order autoregressive time-series model with lagged endogenous variables is:

$$y_t = \alpha + \delta_1 y_{t-1} + \delta_2 y_{t-2} + \ldots + \varepsilon_t$$

$$\varepsilon_t = \rho \varepsilon_{t-1} + \mu_t$$

---

[12] Instead of 12-17, Taiwan arrest reports from 1963 to 1965 used the age category of 12-18. To make my analysis consistent, I only run time-series models for 1966-1991.

where the formula for ε means that this series has first-order autocorrelated residuals and δs indicate the level of the correlation between the current time point and the previous time points.

Then, if ρ is available, we can transform the equation as follows and estimate directly using OLS (see Ostrom 1978)[13]:

$$y_t - \rho y_{t-1} = \alpha(1-\rho) + \delta_1(y_{t-1} - \rho y_{t-2}) + \delta_2(y_{t-2} - \rho y_{t-3}) + \ldots + \mu_t$$

This is the equation on which the augmented Dickey-Fuller test is based. If ρ is equal to 1 in this equation, the series may be generated by a random walk process (also named a unit root process), indicating that the series does not vary around a constant mean but instead "wanders" from a mean level with no tendency to return to the level once it has moved away (LaFree and Drass 2002). It then becomes a first differenced series:

$$y_t - y_{t-1} = \alpha + \delta_1(y_{t-1} - y_{t-2}) + \delta_2(y_{t-2} - y_{t-3}) + \ldots + \mu_t$$

If the above first differenced series has no additional unit root, the process is said to be integrated of order 1. When it has a nonzero intercept α, the series is generated by a random walk process with a drift. This intercept might produce a systematic trend in the sense of a drift in a particular direction. δs are coefficients of the lagged difference terms.

Based on such knowledge, first, we conduct a unit root test to explore the correct specification of a log series of differences between youth and adult crime involvement. If

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[13] Take a lagged form of the first equation and multiply it through by *p* to obtain:

$$\rho y_{t-1} = p\partial + \rho\delta_1(y_{t-1}) + \rho\delta_2(y_{t-2}) + \rho\varepsilon_{t-1}$$

Subtracting this one from the initial equation yields the transformed equation.

the estimation of ρ does not reject the null hypothesis (ρ=1) at .10 level, it shows that this model has a unit root and we should conduct a first-differenced series analysis next.

Then, if there is no additional unit root in the first differenced series, we can use the intercept α to test for a systematic mean decrease or increase for these series[14]. When α is significantly positive, there is a convergent trend between youth and adult crime rates; when α is significantly negative, there is a divergent trend between youth and adult crime rates (the differences keep decreasing); if this intercept is not significant, it means that the difference between youth and adult arrest rates is trendless. Another possibility is that youth offending moves in tandem with adult offending, which make the youth-to-adult difference remain relatively stable over time. Such cointegration is established when one unit root is absent and youth and adult series need the same number of differences to be subject to the same shocks and fluctuations during this period.

The final analysis focuses on the effects of development on the age-crime relationship. Specifically, this study applies annual time-series analysis (see Roberts and LaFree 2004) to explore what leads to variations of the age-crime curve in Taiwan. Consistent with ADF tests, the dependent variable is the log ratio of youth crime rates versus adult crime rates. The major independent variable is the level of development (GDP per capita/HDI). The control variables include growth rate of GDP per capita, Gini index, unemployment, proportion urban population, divorce rate, percent of juvenile

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[14] For both of the steps, different numbers of lagged difference terms are included to eliminate autocorrelations among Ys. ADF tests could tell us how many lagged difference terms we need by testing the significance of δ. For example, if the second δ is not significant, it means one lagged difference is necessary.

population, and police clearance rate. To run this analysis, we add these endogenous variables into the original first-order[15] autoregressive time series equation:

$$y_t = \alpha + \delta_i y_{t-i} + \beta_i x_i + \varepsilon_t$$

$$\varepsilon_t = \rho \varepsilon_{t-1} + \mu_t$$

where x_i refers to different independent and control variables. Sometimes the dependent variable cannot respond immediately to a specific change in the independent variables. In this case, certain lagged terms for endogenous variables may be necessary. But it is almost impossible to specify the exact time that it would take x to affect y (Ostrom, Jr. 1978). Following Roberts and LaFree's models on the relationship between development and crime rates in Japan (2004), this research directly uses the same time points for all variables.

Summary

The present chapter described the sources of data and the methods that this project uses to examine whether, to what extent, and why the age-crime distribution changed in Taiwan from 1961 to 1991. Based on Taiwan arrest statistics and corresponding population data, I calculate age-specific crime rates and then PAIs (percentage age involvement in crime adjusting for age composition in the population). With PAI, the

[15] There is the possibility that residuals in this model are generated by a higher order autoregressive process. For instance, the current disturbance is made up of portions of both the first previous disturbance and the second previous disturbance. But following the ADF test results, I have found the series I used as the dependent variable of this regression model does not need the second-order autoregression. Please see details in Chapter 4.

first two questions above can be addressed by comparing age-crime distribution plots and conducting a dissimilarity (D) test among three typical time points: 1961, 1976 and 1991.

Applying data from all available years, the present study also includes a time-series test for trends in the gap between youth and adult arrest rates to assess whether the crime rates of the two groups are convergent (youth are catching up adults), divergent (adults commit more and more offenses than youth), stable (the gap has little change) or cointegrated (youth criminal offending is in tandem with adult criminal offending).

Finally, for those series with significant positive trends (youth-adult convergence), this research uses annual time series analysis to examine what socioeconomic factors might drive such changes. If the hypotheses in chapter 1 are supported, development is likely to affect the lives of youth in ways that contribute to their greater involvement in crime.

The next two chapters report the results of the data analysis. Chapter 3 focuses on the visual age-crime distribution plots and corresponding statistical comparisons for the years 1961, 1976 and 1991. These comparisons provide a robust view of whether the age-crime relationship in Taiwan has changed during this time period and if there is any change, how large it is. The different types of offenses are also taken into account. Chapter 4 examines the results of time-series analysis—the ADF tests tell us what series (the log ratio of youth and adult crime rates for different offenses) have the expected changes from 1961 to 1991, while the annual time series analysis examines the effects of development on such changes.

Chapter 3

Descriptive Analysis

The purpose of this chapter is to examine whether the shape of the age-crime distribution is invariant. It describes the age age-crime curves seen in cross-sectional official criminal statistics and investigates variation in these curves over time, type of crime, and place (Taiwan and the United States).

Taiwan Age-Crime Curves

The plots titled A-D in Figure 3.1-3.3 show the relationship between age and *recorded* crime for Taiwan in the years 1961, 1976 and 1991, standardized by demographic age composition (through PAI). As I mentioned before, 1961 was the start point of Taiwan economy lift-off and also a census year in Taiwan (TW Year 50). 1991 (TW Year 80) was another census year after 30 years. Between 1961 and 1991, 1976 services as a convenient middle point. To add stability to the crime figures, this study uses the average of the arrest numbers by offense types for the years 1961-62, 1976-77, and 1991-92. Appendix C lists all PAI values by age, year and type of offenses.

The age breakdowns for these three years differ somewhat. As discussed in Chapter 2, the present study recodes the age groups for years 1976 and 1991 to be consistent with the age categories of 1961. The final age groups in the A-D plots of Figure 3.1-3.3 are below 14 (in fact it refers to “10-13” since children below age 10

commit very few offenses), 14-17, 18-20 and ten-year categories for the remaining ages (71-79 is the last category).

This study also examines the age-crime relationship more thoroughly using individual ages from 10 to 29 in 1976 and 1991. The plots titled lowercase a-d of Figure 3.1-3.3 show the age-crime relationship for years 1976 and 1991, applying single-year groups for ages 10 through 29 and ten-year groups for the remaining ages. Appendix D lists their PAI values by age, year, and type of offenses. Since the age breakdown in the plots named A-D is very robust, when we describe the age-crime curves, we should consider plots A-D and plots a-d together.

The age-crime curves may be quite different over types of offenses. Taiwan crime statistics consistently report six types of offenses from 1961 to 1991. Those are homicide, assault, robbery, larceny, stolen property, and fraud. The first three are violent offenses, while the latter three are property offenses. I draw age-plots for all these offenses, plus plots for violent index, property index, and total offenses. Figure 3.1 displays plots for homicide, aggravated assault, robbery, and violent index. Figure 3.2 shows plots for larceny, stolen property, fraud, and property index. Figure 3.3 plots the age-crime distribution for total offenses.

Age Curves for Violent Offenses

In Figure 3.1A, the age-homicide distribution differs somewhat across the years—the distribution in 1991 has no clear peak age (as high at age 35 as at ages18-20), in comparison with the peak of homicide involvement in 1976 and 1961 falls in the age

category of 18-20. Visually, the 1961 curve is even more peaked than the 1976 curve. We can describe this using the peak PAI values: 36.71% of homicide arrests in 1961 occur in the age group of 18-20 compared to 32.60% in 1976. In other words, homicide offenses are more widely distributed in 1976 and even more so in 1991. Observing the 1976 and 1991 plots which contain more specific age breakdown (Figure 3.1a), we find that the 1991 homicide curve has a later peak age than 1976 (18 in 1991 versus 17 in 1976). Instead of an inverted-J shape (crime involvement drops dramatically after youth), the 1976 and 1991 homicide curves do not consistently decrease after late teenage years. Instead, the distributions jump again at early 20s and then keep a relative stable level thereafter. The final drop occurs after 30.

Figure 3.1B shows that the age-crime distribution for assault is more peaked and peaks earlier in 1961 (18-20) than in 1976 (almost no peak age, 18-40 at about the same level) and in 1991 (31-40). Examining the 1976 and 1991 curves only (Figure 3.1b), we find that the 1976 distribution is more peaked and peaks earlier (age 17) than the 1991 distribution (age 29). Instead of the unimodal (i.e. having only one peak point) shape, the 1976 curve has two increasing periods: one is in teenage years and the other is in 20s. Obviously, the 1991 curve is more widely distributed and more concentrated in late ages compared to the 1976 curve.

Based on Figure 3.1C and Figure 3.1c, robbery seems the only violent offense consistent with the traditional unimodal age-crime distribution, especially in the years 1961 and 1976. Curves in these two years have only one peak, peak in the young ages (19 in 1961 and 17 in 1976), and then drop dramatically thereafter. Robbery in 1991 is

more dispersed and peaks later. Specifically, the peak PAI in 1991 is 8.60% at age 18, while the peak PAI in 1976 is 13.62% at age 17.

Combining homicide, assaults, and robbery together, Figure 3.1D indicates the age-crime relationship for violent index in 1961, 1976 and 1991. Although all of them peak in the age group 18-20, the distribution in 1961 is more peaked than the other two years, comparing their peak PAI values (31.17 in 1961 versus 23.82 in 1976 and 18.73 in 1991). Turning to the individual-age plot (Figure 3.1d), the violence involvement in fact peak at age 17 in 1976 and at age 18 in 1991. Similar to homicide, assaults, and robbery, the curve for the violence index in 1991 generally is more dispersed and concentrates among older ages than the curve in 1976.

Age Curves for Property Offenses

In Figure 3.2A, the peak of the age-larceny distributions in 1991 and 1976 (age 14-17) is earlier than the peak in 1961 (age 18-20). The 1961 curve also looks more dispersed than the curves in the other two years. Focusing on 1991 and 1976 (Figure 3.2a), the larceny curve in 1991 is more peaked than in 1976: 12.43% of larceny arrests in 1991 occurs at the peak age 14 compared to 9.22% in 1976 at the peak age 17. Similar to the curves for those violent offenses, both the distributions increase again at early 20s and then keep a relative stable level thereafter. The final drop occurs after 30. But the level of such increasing is much smaller than violent offenses.

Figure 3.2B reflects that the age-crime distribution for stolen property is more peaked and concentrates among younger ages in 1991 than in the years 1976 and 1961.

The latter two curves are more dispersed and even peak at middle ages. Exploring the 1976 and 1991 curves with more age information (Figure 3.2b), we can see that the peak age in 1991 is 14, while the peak age in 1976 is 25. Moreover, the 1991 distribution is almost unimodal (after 14 dropping dramatically), in comparison with the 1976 curve increasing in both teenage years and in 20s (drop after 29).

Based on Figure 3.2C, fraud seems not changing too much from 1961 to 1991. All these three distributions peak in middle ages and are nearly symmetrical. The peak PAI value in 1991 (23.51) is a little bit smaller than in the other two years (29.47 in 1976 and 30.60 in 1961), indicating that the curve in 1991 may be slightly less concentrated toward youth. Comparing the 1976 and 1991 only (Figure 3.2c), the peak age in 1991 (24) is earlier than it in 1976 (29). But the curve in 1991 is more dispersed (even containing a certain level of involvement in teen ages), in comparison with the 1976 curve which is more concentrated among late 20s and 30s.

Adding larceny, stolen property and fraud together, Figure 3.2 D indicates the age-crime relationship for property index in 1961, 1976 and 1991. The shape of these three distributions is very similar to the curves for larceny, indicating that property index may be mainly driven by larceny. The 1991 and 1976 curves peak at earlier ages and are more concentrated among youth compared to the 1961 curve. Turning to the individual-age plot (Figure 3.2d), the proportionate property involvement peaks at age 17 in 1976 and age 14 in 1991. Clearly, the 1991 distribution is more peaked and more concentrated among youth than the 1976 distribution.

Curves for Total Offenses

Figure 3.3A draws the age-crime curves for Taiwan total offenses in 1961, 1976 and 1991. It is hard to find a peak point in these three distributions. The arrests for total offenses seem almost evenly distributed among population groups 14-17, 18-20, 20s, and 30s (and then drop). In Figure 3.3a (with more information on individual ages), instead of the unimodal (i.e. having only one peak, peaking in the young ages, and then dropping dramatically thereafter) curves, the age distributions for total crime in 1976 and 1991 actually increase in two periods and never drop very quickly: the first growth occurs in the mid-teenage years and the second at 20s. Compared to the 1976 distribution, the 1991 curve has a later peak age in the mid-teenage years (18 in 1991 versus 17 in 1976), while it has an earlier peak age at 20s (24 in 1991 versus 26 in 1976). Both of the distributions keep a constant level at 20s and then drop after age 29.

Statistical Assessment of Age Shifts in Age-Crime Curve

Table 3.1 characterizes these curves on a variety of measures. Table 3.1A reports measures on the age-crime curves in 1961, 1976, and 1991 (with broad age categories), while Table 3.1a focuses on the age-crime distributions in 1976 and 1991 (with more specific age breakdown). Besides the peak age and the peak PAI values I have mentioned above, I also include skewness and kurtosis. Skewness reflects the degree to which a distribution is symmetrical (zero), skewed to the right (positive value), or skewed to the left (negative value). Kurtosis shows the extent to which a distribution is peaked around its center or flattened. The normal distribution has a kurtosis value of zero.

Values greater than zero show that the curves are more peaked than the normal distribution, or vice versa.

According to the previous argument on the relationship between development and the age-crime distribution, with socioeconomic development, the age-crime distribution will become more concentrated among youth (skew to the right) and more peaked at younger ages. Looking through Table 3.1A, only larceny and property index (but swamped by larceny) match such process. The curve for Taiwan larceny is nearly symmetrical in 1961 (skewness=0.38) but become skewed to the right in 1976 (skewness=1.04) and even more so in 1991 (skewness=1.46). Moreover, the larceny curve in 1961 is very flat (kurtosis=-1.25), while the curve in 1976 becomes close to the normal distribution (kurtosis=0.72) and then turns to be more peaked than the normal distribution in 1991 (kurtosis=2.51). Similar trends are found for the curves of the property index.

Examining the 1976 and 1991 curves more closely with specific age breakdown, Table 3.1a tells us that similar to property index and larceny, the distribution for stolen property also becomes more peaked and more concentrated among youth over time (at least from 1976 to 1991).

In summary, age-crime curves in Taiwan are not always unimodal as the invariancy argument predicted (Hirschi and Gottfredson 1983). Most distributions are bimodal or almost nonpeaked. Opposite to the hypothesis I (with development, the age-crime curves are more peaked and concentrated among youth), violent offenses in Taiwan become more dispersed and even peaked later over this time period and the total crime curve in Taiwan also do not change too much. Larceny, stolen property and

property crime index are more peaked and concentrated among youth over time, which seems to match my hypothesis. Although the fraud distribution does not show a clear trend through values of skewness and kurtosis, the curve does reflect that its peak age in 1991 is earlier than in 1976 and the youth involvement in 1991 is more than in the years 1961 and 1976. These signs indicate that fraud as one of property offenses may tend to follow the hypothesis even though it still tends to be a common crime for the middle-aged.

The Dissimilarity Test

Next, I use the dissimilarity (D) test to examine whether the age-crime curves shift significantly over time, and, if so, in which period the shift occurs. Recall that one thumb of rule to ascertain "significance of D" is a change at 15 or greater (Steffensmeier et al. 1989). Table 3.2A reports the D values for the three pairs of comparison: 1991 versus 1976, 1976 versus 1961, and 1991 versus 1961. The first column shows that the 1991 curves for homicide, robbery, stolen property and property crime index are significantly different from the corresponding 1976 curves. The second column reveals that only homicide, robbery and larceny have significant shifts between 1961 and 1976. The last column indicates that the 1991 curves for homicide, robbery, assault, larceny, stolen property and property crime index (swamped by larceny) are significantly different from the corresponding 1961 curves. Taken them together, we find that violent index, fraud and total offense have relatively stable distributions across all three periods; the major shifts for stolen property occurs after 1976; the shifts for assault are gradual (not

significant over each 15-year period) and can be detected only when comparisons are made in a long time frame (in this study, 30 years).

Table 3.2a applies the specific age categories to do a more thorough D test for curves in 1976 and in 1991. The first column is consistent with Table 3.2A, reporting the D values for age 10-50. To reduce the noise from different age categories, I also include a column only using the individual ages 10-29. Both columns show that the 1991 curves for robbery and all property offenses are significantly different from the corresponding 1976 curves.

Combining these two tables, it seems that the shift for homicide mainly occurs in the first period (from 1961 to 1976), while the shifts for stolen property, fraud and property index mainly occur in the second period (from 1976 to 1991). The robbery and larceny distributions are changing across all three decades. Assault has a gradual change that is difficult to detect until taking all the time together. Based on the previous descriptive results, among these significant shifts, the shifts of larceny, stolen property, fraud, and property index are in the expected direction (Hypothesis 1). That is, their distributions are more peaked and more concentrated among youth over time. The shifts for assault, robbery and homicide are opposite in the direction of flatter and even peak at older ages over time.

Comparing Taiwan and the United States

One of the purposes of this research is to examine whether the age-crime relationship varies across societies. Based on the UCR data and corresponding

population numbers in the United States, this study calculates PAI and then draws the U.S. age-crime distributions in 1980 (similar to the methods dealing with the Taiwan data). Figure 3.4 shows the U.S. age-crime distributions by type of offenses in the year 1980. Plot a is for violent index; plot b is for property index; plot c is for total offenses. The age categories in the UCR report of 1980 were 10-12, 13-14, singles ages 15 through 24 and five-year groups for the remaining ages (65-69 is the last category). To be consistent with the age-crime plots for Taiwan, I adjust the PAI scale in the U.S. plots from 15 to 20. Therefore, the curves look less peaked than the previous studies on the U.S. age-crime distributions (Steffensmeier et al. 1989; Hirschi and Gottfredson 1983; Farrington 1986).

The Human Development Index score for Taiwan in 1991 is about .823 (see Chapter 4), which is close to .883 the U.S. value in 1980 (UN Human Development Report 2003). In other words, the level of development in Taiwan in 1991 is close to the US development level in 1980. Therefore, comparisons between Taiwan's 1991 age-crime distribution and the 1980 age-crime curves in the United State are legitimate. Comparing Figure 3.1d with the violent curve in Figure 3.4a, we can see that the major difference between the two is that the US curve is unimodal (peaking at age 17-18 and then dropping gradually, especially after age 24), while the Taiwan curve has two most concentrated age periods (the PAI as high at age 18 as at ages 24-29).

There are more similarities between the Taiwan and U.S. age curves for property crime index (Figure 3.2 d versus Figure 3.4 b): peaking at young ages, concentrating among youth, and then dropping dramatically. It is noticeable that the Taiwan age curve for property crime peaks at age 14, even two years earlier than the curve in the United

States. The reason might be the Taiwan property crime is heavily swamped by larceny, while the U.S. property index contains more types of property offenses. There is a little bit growth at early 20s in the Taiwan age curve for property index, which can be explained by the military draft of Taiwan youth.

Similar to violent index and even more so, the 1991 Taiwan age distribution (Figure 3.3 a) for total offenses is very dispersed and difficult to locate a peak age; the offenses concentrate both at the age group of 15-19 and at the age group of 22-29. In contrast, the 1980 U.S. curve for total offenses (Figure 3.4 c) is unimodal (peak at age 18 and then drop gradually, especially after age 24). An interesting finding is that the U.S. age-crime curve for total offenses is very similar to its distribution for violent index.

Steffensmeier and his colleagues explored the age-crime relationship in the United States over time in detail (1989). Based on their study, Table 3.3 reports the peak ages, skewness, kurtosis, and D-values for the U.S. age-crime distributions in 1940, 1960 and 1980. The development process of the U.S. during this time period is robustly close to the transition in Taiwan from 1961, 1976 and 1991, although Taiwan experienced a more rapidly social change than the U.S. Therefore, it seems comparable between Table 3.1 (measures on the Taiwan age-crime curves) and Table 3.2 (measures on the U.S. age-crime curves). These tables are also broken down by same types of offenses[16].

For most offenses in the United States (except fraud that is stable over time), the peak age keeps descending over time. Differently, the Taiwan age curves for violent

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[16] The larceny offense in Taiwan arrest statistics actually include both common larceny and auto theft, while in the FBI crime report, larceny and auto theft are separate. For a better comparison, Table 3.4 lists measures on both larceny and auto theft.

offenses tend to peak later over time; the peak age of the Taiwan age-crime curve for total offenses increases in the first period and then drops in the second period. Another difference is that in most recent years, Taiwan peak ages for larceny and stolen property are almost two years earlier than the United States, while the assault peak age in the United States is much earlier than it in Taiwan. However, Taiwan and the U.S. seem having similar peak ages for robbery, homicide and fraud.

The second column of Table 3.3 shows that in the United States, all offenses are skewed to the right over time, while in Taiwan, violent offenses, stolen property and total offenses are slightly skewed to the left. Moreover, the U.S. curves for all offenses become progressively less symmetrical or more skewed to the right, from 1940 to 1960, from 1960 to 1980, or through the whole period. Contrarily, the Taiwan curves for homicide, assault, robbery and fraud become more symmetrical or more skewed to the left over time.

When examining Kurtosis values, the general trend in the United States is a steady movement toward more peaked age-crime distributions, although most of them remain flatter than the normal distribution. However, in Taiwan, except larceny and stolen property, all the other offenses tend to be less peaked over time.

Comparing the D values in Table 3.2 and Table 3.3, Taiwan age-crime distributions have more significant variations over the 1961-1991 period than the age-crime curves in the United States from 1940 to 1980. Specifically, fraud in Taiwan has a significant shift to younger ages in the late development period (1976-1991), while fraud in the United States does not vary too much during the period of 1940-1980; only larceny and auto theft in the United States display significant shifts in the first development

period (1940-1960), while in Taiwan this category is consistently changing during the whole period (1961-1991); robbery in Taiwan significantly varies across all time periods, whereas in the United States, robbery only has gradual changes that is hardly to detect until we put all the forty years together; total offenses in Taiwan does not significantly vary over time, whereas in the United States, it changes gradually and the shift becomes significant if we put all the forty years together. Another noticeable finding is that the significant variation for stolen property in Taiwan occurs in the second development period (1976-1991), which fall behind the shift of larceny. In contrast, the US stolen property curve has a major shift in the first development period, the same time as the larceny curve changes.

Taken together, these findings demonstrate that the age-crime distributions in the United States are quite different from the curves in Taiwan. The differences also vary over time and across types of offenses.

Summary

Overall, this chapter applies descriptive methods to describe the age-crime distributions in Taiwan for years 1961, 1976 and 1991, including easily interpreted plot-displays of age-crime curves. The results show that property offenses in Taiwan are roughly consistent with the Hypothesis I: the shape of the age distribution is more peaked in 1991 than in earlier periods (moving from bimodal to unimodal); all shifts in the age-crime distributions for property offenses are toward an earlier peak and a more skewed (to the right) distribution. However, it is noticeable that such shifts are relatively small

for property offenses primarily involving older offenders (e.g. fraud). These findings indicate that with development, young people in Taiwan may be exposed to more criminogenic factors (e.g. peer culture, weak supervision, and role strain) and thus become more likely to involve in property crime.

The Taiwan age-crime distributions for violent offenses show a contradiction to the Hypothesis I: the distributions are more dispersed and even peak later over time; instead of the unimodal shape, violent offenses tend to be bimodal across all the three time periods. Such findings imply that the development process may have smaller impacts on youth violent crime involvement in Taiwan; or certain cultural or specific social factors in Taiwan have meliorated the effects of development.

I also compare Taiwan age-crime distributions with the corresponding analysis for the United States. Based on the plots made by myself and prior work done by Steffensmeier and his colleagues (1989), I find that the age-crime distributions in Taiwan for property crimes are similar to the age-crime distributions in the United States, although some parameters are different: both of them toward the unimodal shape, the young peak age, and the concentration among youth with development. This result is consistent with the Hypothesis II.

For violent offenses and total offenses, there are substantial differences between Taiwan and the United States in terms of the basic shape, the measures on the distributions and the shift direction with development. Specifically, for violent offenses and total offenses, Taiwan age-crime distributions tend to be bimodal and have a much greater dispersed distribution for ages 14 through 40. This finding is consistent with the

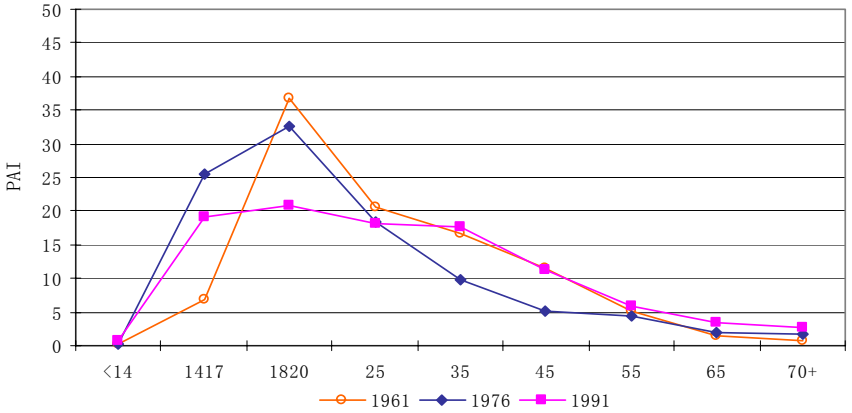
Hypothesis III, indicating that the two societies are different in certain ways and Taiwan does not quite follow the modernization process of the Western societies.

In sum, all these findings demonstrate that the age-crime distributions vary over time, place and type of offenses; moreover, the changes are substantial, including changes in both the basic shape and many important parameters. These results are significantly different from Hirschi and Gottfredson's invariancy argument.

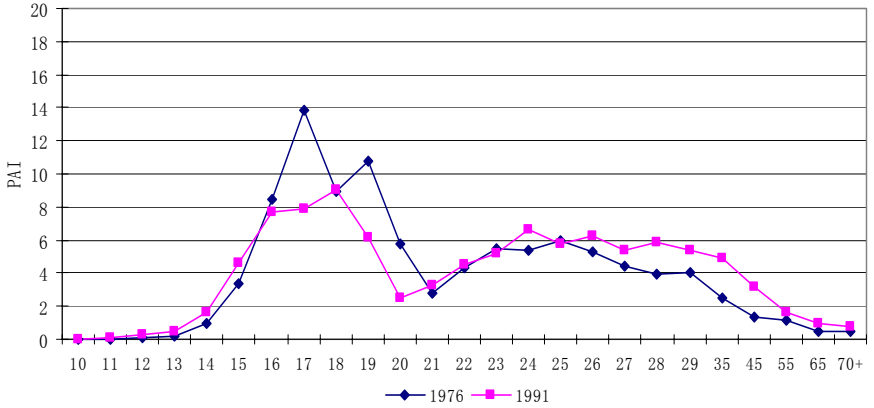
In Chapter 4 that follows, I apply time series techniques to assess the impact of development on the age-crime relationship in Taiwan, focusing on juveniles (age 12-17) and active adults (age 18-49) over the period of 1961-1991.

Figure 3.1 Taiwan Age-Crime Distributions for Violent Offenses, 1961, 1976 and 1991.

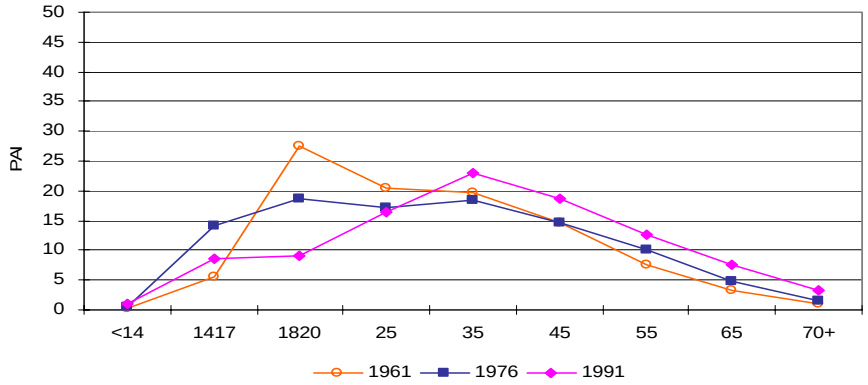
A. Homicide, 1961, 1976 and 1991



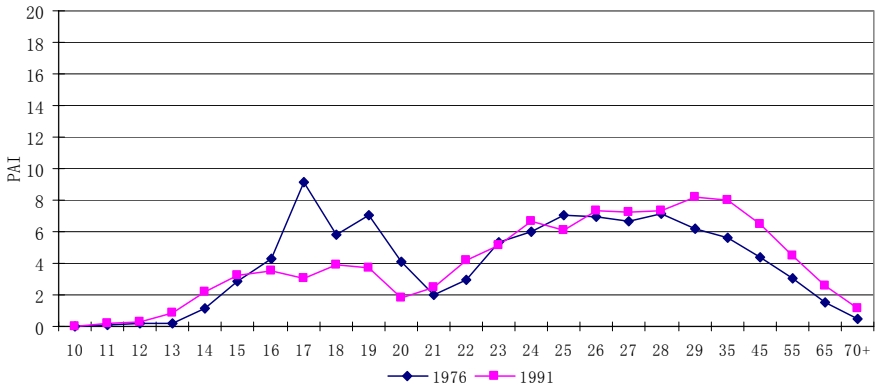
a. Homicide, 1976 and 1991[a]



B. Aggravated Assault, 1961, 1976 and 1991

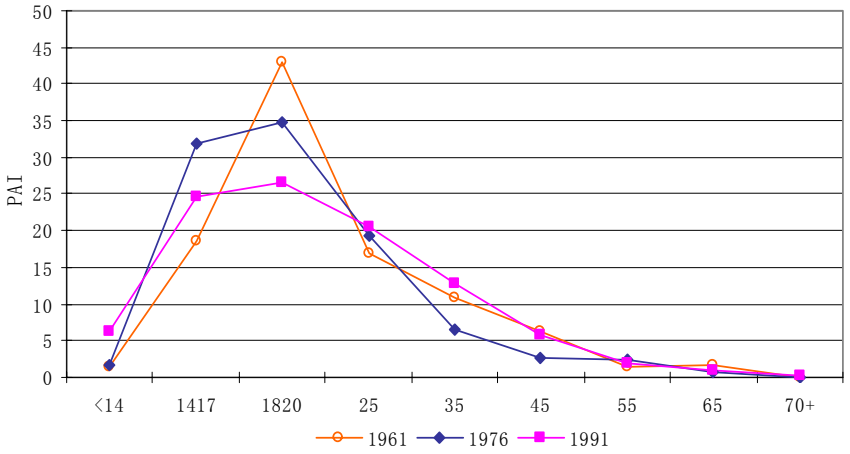


b. Aggravated Assault, 1976 and 1991

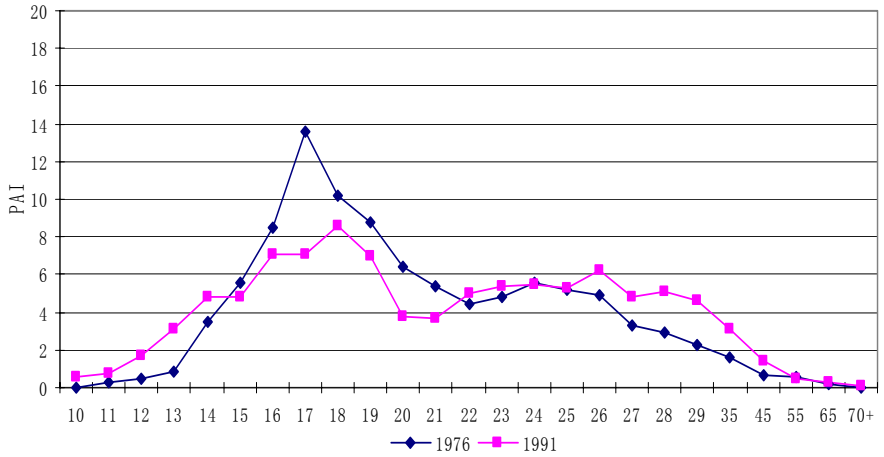


a. The lower-case plots contain individual-year breakdown for ages 10-29.

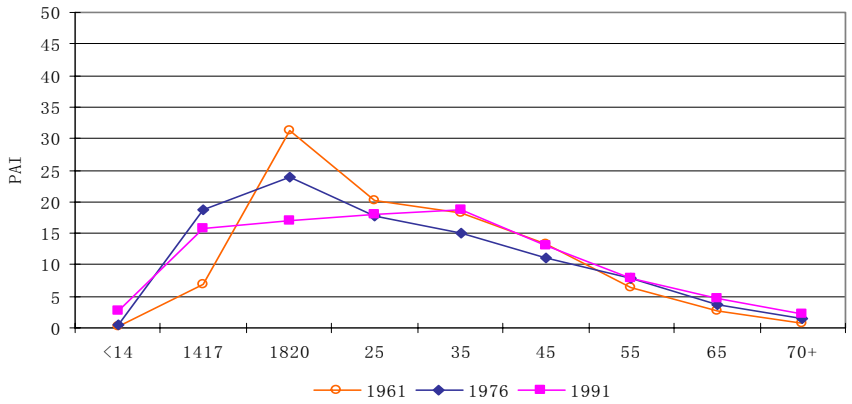
C. Robbery, 1961, 1976 and 1991



c. Robbery, 1976 and 1991



D. Violent Index, 1961, 1976 and 1991



d. Violent Index, 1976 and 1991

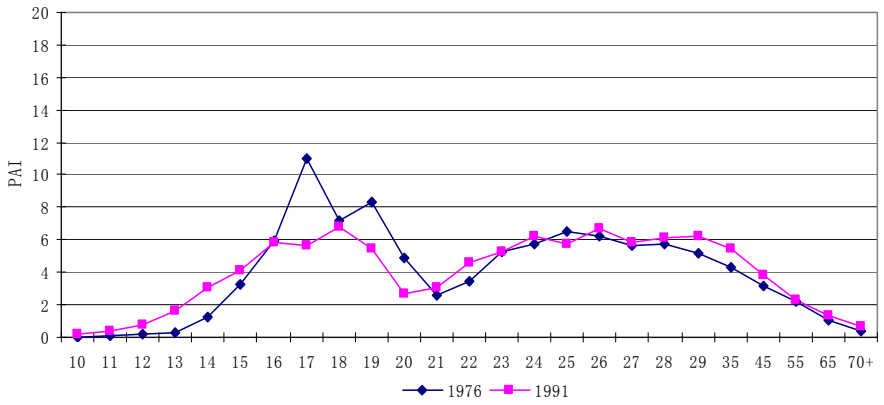
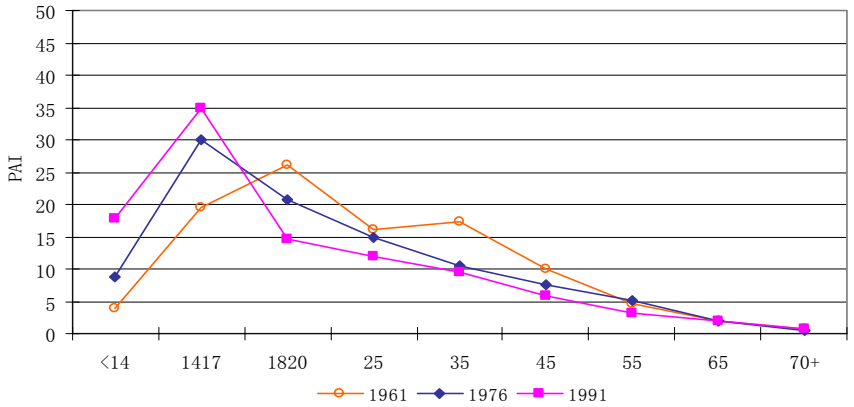
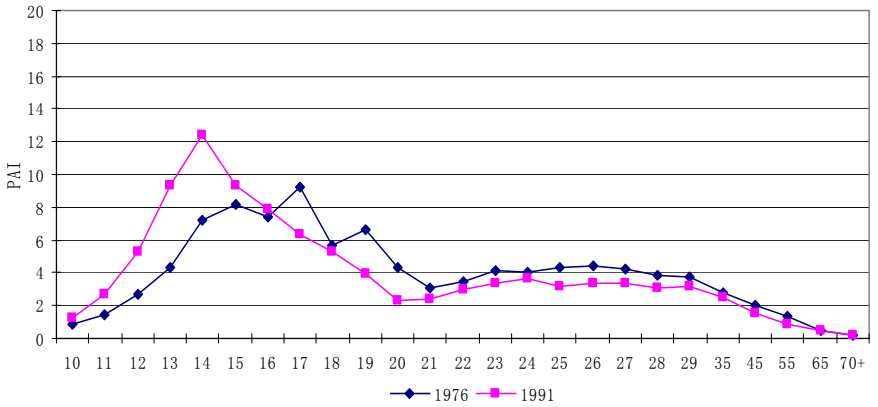


Figure 3.2 Taiwan Age-Crime Distributions for Property Offenses, 1961, 1976 and 1991.

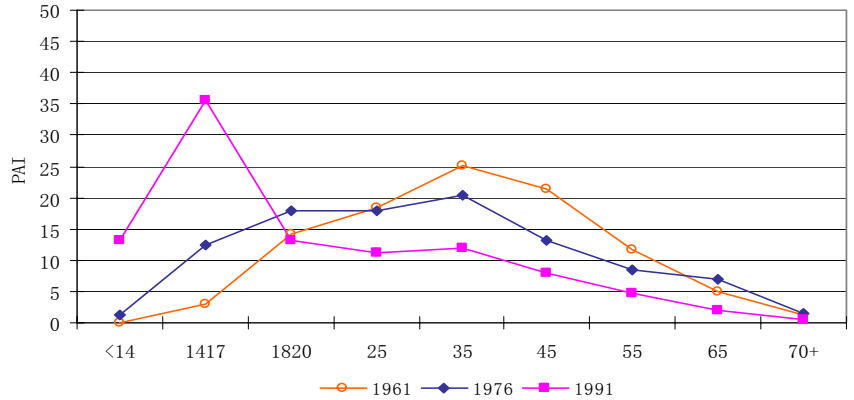
A. Larceny, 1961, 1976 and 1991



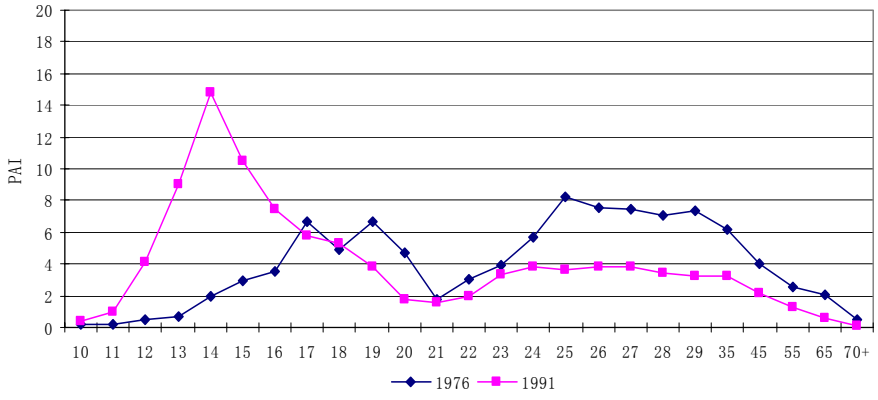
a. Larceny, 1976 and 1991[a]



B. Stolen Property, 1961, 1976 and 1991

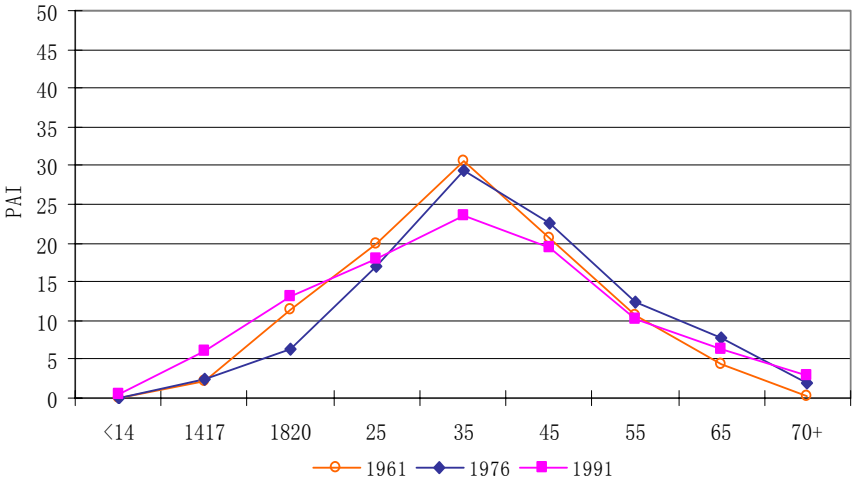


b. Stolen Property, 1976 and 1991

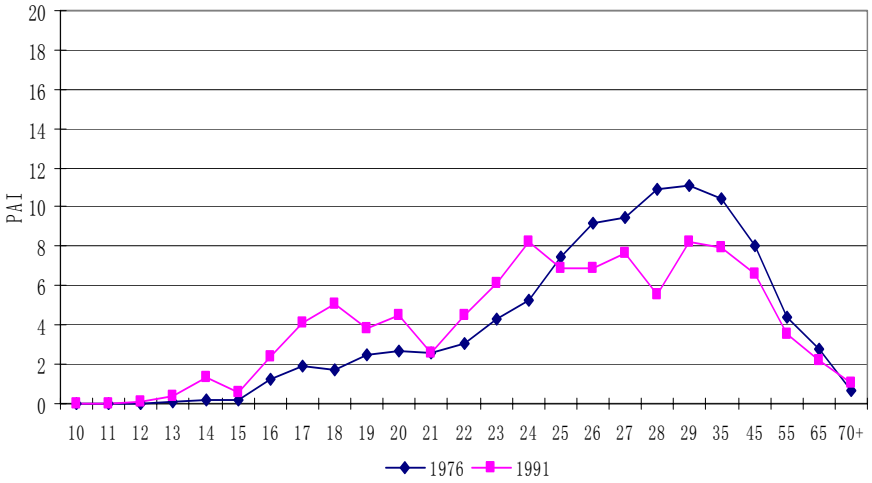


a. The lower-case plots contain individual-year breakdown for ages 10-29.

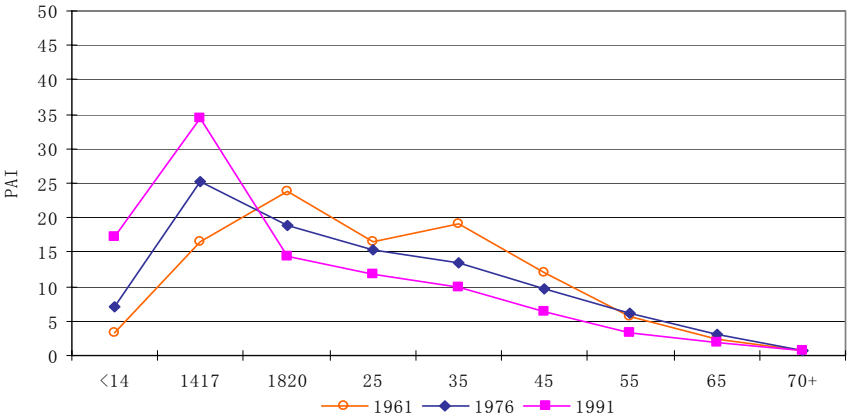
C. Fraud, 1961, 1976 and 1991



c. Fraud, 1976 and 1991



D. Property Index, 1961, 1976 and 1991



d. Property Index, 1976 and 1991

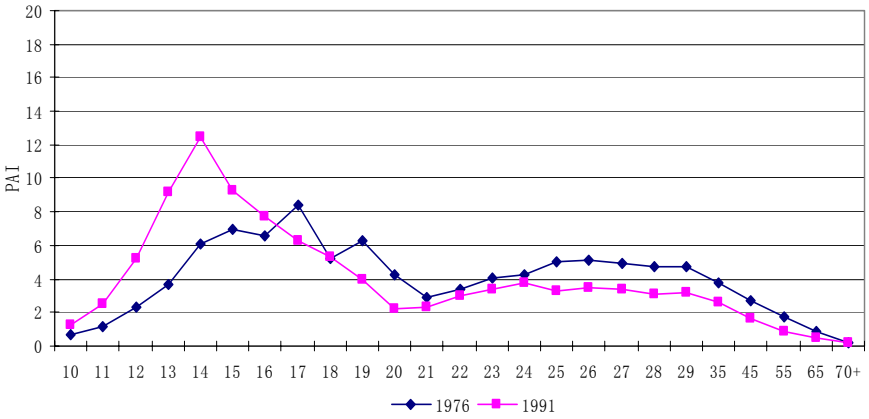
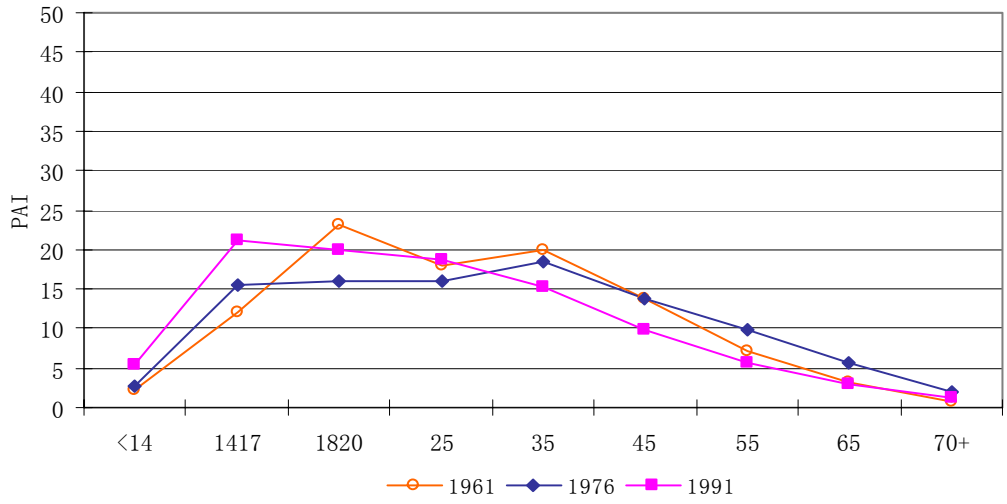
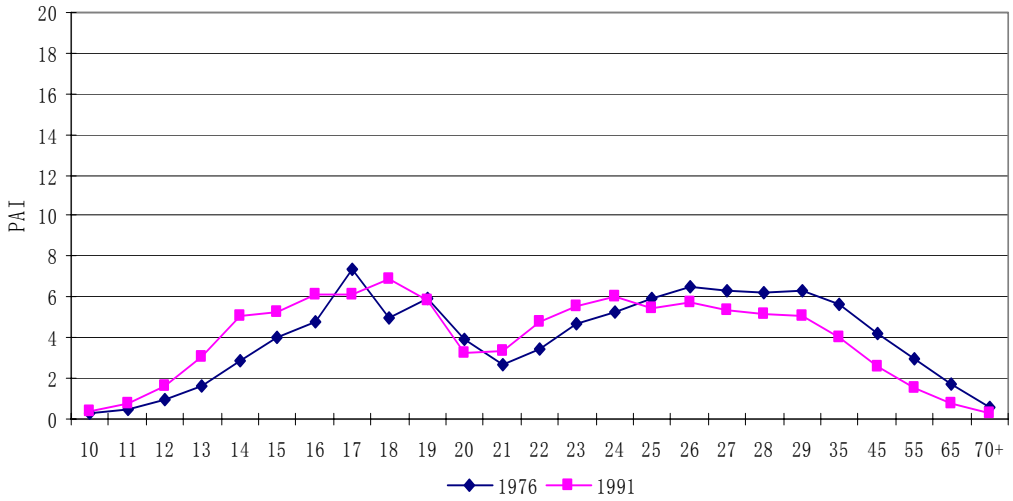


Figure 3.3 Taiwan Age-Crime Distributions for Total Offenses, 1961, 1976 and 1991.

A. Total Offenses, 1961, 1976 and 1991



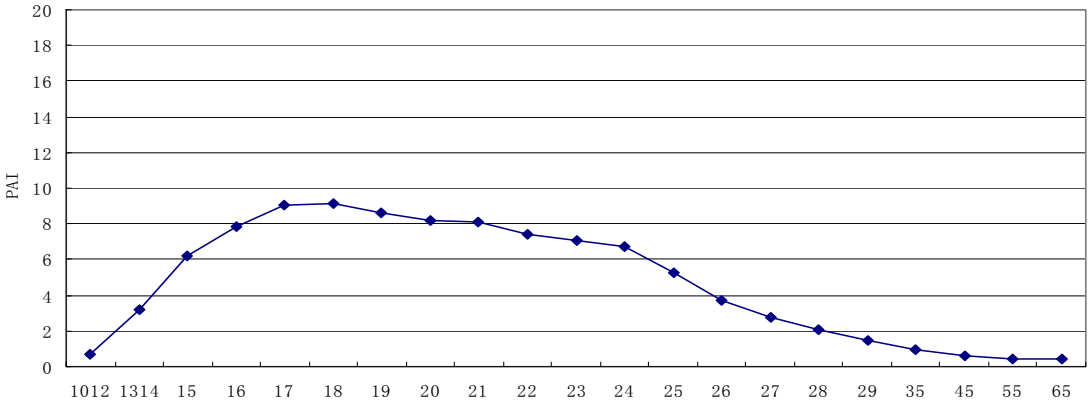
a. Total Offenses, 1976 and 1991[a]



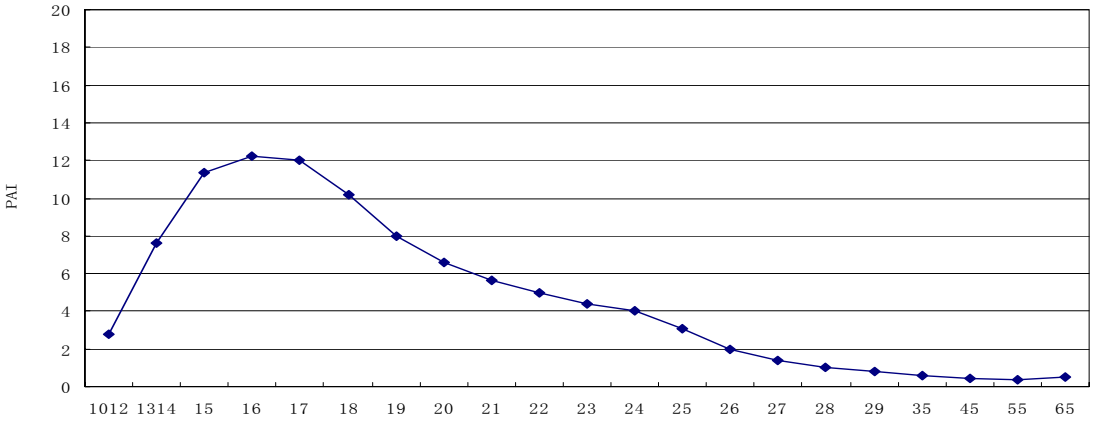
a. The lower-case plots contain individual-year breakdown for ages 10-29.

Figure 3.4 The Age-Crime Distributions in the United States, 1980

a. Violent Crime Index (homicide, forcible rape, robbery, and aggravated assault)



b. Property Crime Index (larceny, auto theft, burglary, and arson)



c. Total Offenses

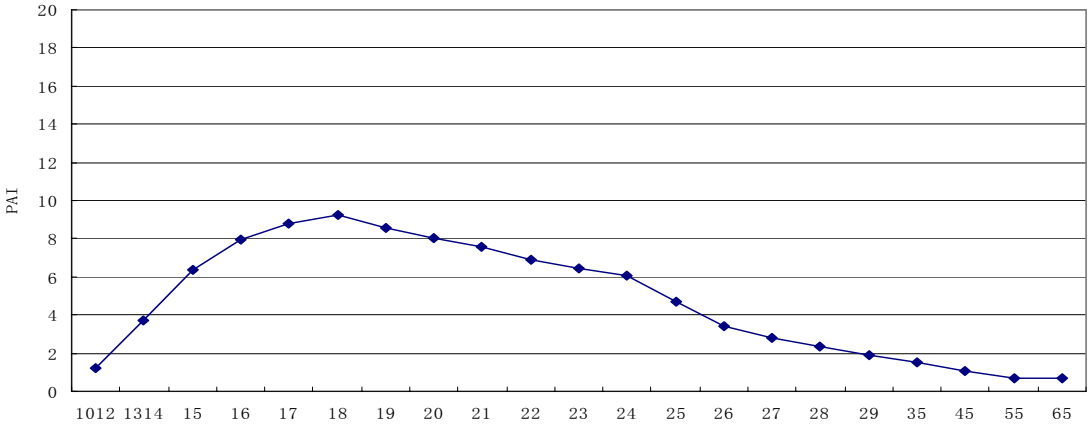
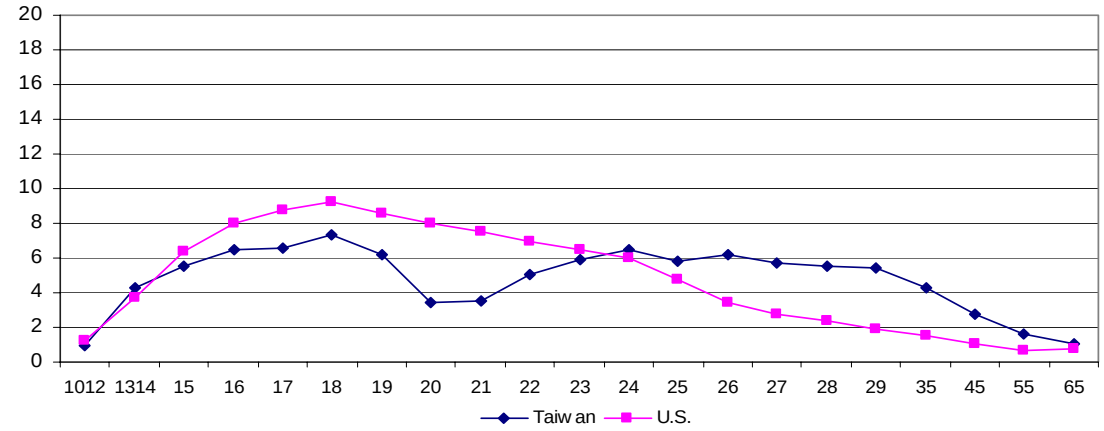
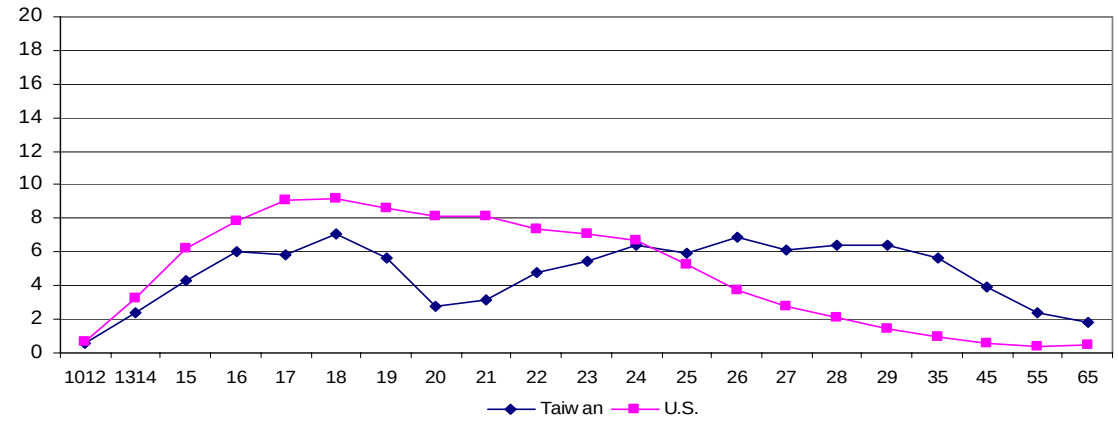


Figure 3.4 supplemental

Taiwan Total Offenses vs U.S. Total Offenses



Taiwan Violent Index vs U.S. Violent Index



Taiwan Larceny vs U.S. Property Index

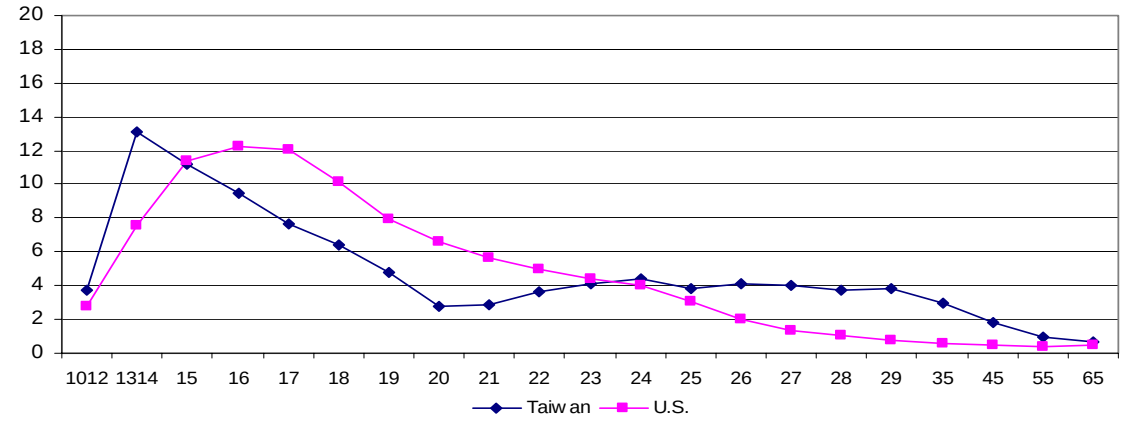


Table 3.1A Descriptive Tables: Summarizing the Age-Crime Curves, 1961, 1976 and 1991 (based on Figure 1-3 capitalized plots)

	Total			Violence			Property		
	1961	1976	1991	1961	1976	1991	1961	1976	1991
Peak age	19	35	15.5	19	19	35	19	15.5	15.5
PAI at peak	23.13	18.41	21.06	31.17	23.82	18.73	23.76	25.3	34.34
Skewness	0.12	-0.5	0.11	0.86	0.09	-0.28	0.11	0.53	1.47
Kurtosis	-1.58	-1.56	-1.95	-0.02	-1.4	-1.98	-1.63	-0.4	2.63

	Homicide			Aggravated Assault			Robbery		
	1961	1976	1991	1961	1976	1991	1961	1976	1991
Peak age	19	19	19	19	19	35	19	19	19
PAI rate at peak	36.71	32.6	20.87	27.54	18.62	23	42.98	34.76	26.67
Skewness [a]	1.33	1	-0.06	0.49	-0.53	0.28	1.76	1.08	0.52
Kurtosis [b]	1.59	-0.41	-2.11	-1.23	-1.51	-0.77	3.37	-0.63	-1.59

	Larceny			Stolen Property			Fraud		
	1961	1976	1991	1961	1976	1991	1961	1976	1991
Peak age	19	15.5	15.5	35	35	15.5	35	35	35
PAI at peak	26.11	30.06	34.76	25.18	20.36	35.47	30.6	29.47	23.51
Skewness	0.38	1.04	1.46	0.24	-0.23	1.79	0.7	0.77	0.26
Kurtosis	-1.25	0.72	2.51	-1.56	-1.35	4.3	-0.56	-0.48	-1.24

Note: the shading numbers indicate that the changes are toward the expected direction.

a. Skewness: 0=symmetrical; positive value=skew to the right; negative value=skew to the left.

b. Kurtosis: 0=normal distribution; >0 means more peaked than normal distribution; <0 means fatten than normal distribution.

Table 3.1 a: Descriptive Tables: Summarizing the Age-Crime Curves, 1976 and 1991 (based on Figures 1-3 lower-case Plots)

	Total		Violence		Property	
	1976	1991	1976	1991	1976	1991
Peak age	17	18	17	18	17	14
PAI at peak	7.36	6.87	11	6.82	8.38	12.46
Skewness	-.36	-.62	.33	-.46	-.05	1.34
Kurtosis	-1.06	-1.05	-.24	-1.28	-.44	1.66

	Homicide		Aggravated Assault		Robbery	
	1976	1991	1976	1991	1976	1991
Peak age	17	18	17	29	17	18
PAI rate at peak	13.87	9.03	9.14	8.18	13.62	8.6
Skewness	1.04	-.03	-.07	.14	.95	-.19
Kurtosis	.95	-1.13	-1.23	-1.19	.70	-.88

	Larceny		Stolen Property		Fraud	
	1976	1991	1976	1991	1976	1991
Peak age	17	14	25	14	29	24
PAI at peak	9.22	12.43	8.2	14.81	11.06	8.2
Skewness	.44	1.32	.03	1.70	.72	.01
Kurtosis	-.20	1.53	-1.36	3.40	-.93	-1.37

Note: the shading numbers indicate that the changes are toward the expected direction.

Table 3.2A The Dissimilarity Tests for Taiwan Age-Crime Distributions, 1961, 1976 and 1991 (Age 10-50)

	Index of Dissimilarity [a]		
Offenses	91/76 b	76/61	91/61
Violent:			
Homicide	16.5	19.1	16.0
Aggravated Assault	12.8	11.2	17.0
Robbery	15.3	16.1	16.8
Index	9.0	13.6	14.1
Property:			
Larceny	12.7	15.6	28.3
Stolen Property	30.0	13.7	40.1
Fraud	10.3	5.5	8.1
Index	17.1	13.2	30.3
Total Offenses	10.9	7.3	12.5

a Index of Dissimilarity (D) = $\frac{1}{2}\sum\left|o_{iji1} - o_{iji2}\right|$, where o_{iji1} =percentage of arrests for age group *i* for offense *j* at time 1, and o_{iji2} =percentage of arrests for the same age group and offense at time 2. D-values of 15 or higher reflect significant difference, while values below 15 indicate similarity.

b Two year averages are used to estimate data in 1961, 1976, and 1991.

Table 3.2a: The Dissimilarity Tests for Taiwan Age-Crime Distributions, 1976 and 1991 (Age 10-50 and Age 10-29)

	Index of Dissimilarity	
	91/76	91/76
Offenses	(Age 10-50)	(Age 10-29)
Violent:		
Homicide	14.5	12.3
Aggravated Assault	14.0	11.7
Robbery	16.7	15.6
Index	11.4	10.5
Property:		
Larceny	15.7	15.4
Stolen Property	36.1	33.8
Fraud	17.4	15.5
Index	19.5	18.4
Total Offenses	11.0	9.4

Note: the shading numbers indicate that the changes are toward the expected direction.

Table 3.3 The Descriptive Table for the Age-Crime Distributions in the United States, 1940, 1960 and 1980

OFFENSE	PEAK AGE IN			SKEWNESS IN			KURTOSIS IN			INDEX OF DISSIMILARITY		
	1940	1960	1980	1940	1960	1980	1940	1960	1980	80/60	60/40	80/40
Violence												
Homicide	23	24	19	0.37	0.36	0.49	-0.82	-0.92	-0.72	6	7.1	11.9
Assault	23	24	21	0.28	0.27	0.43	-0.9	-0.83	-0.74	11.7	8.5	20
Robbery	19	19	17	0.9	0.88	1.08	-0.71	0.19	0.08	12.3	13.4	25.2
Property												
Larceny	18	16	16	0.58	1.02	0.95	-0.71	0.19	0.08	5.1	30.1	25.1
Auto Theft	18	16	16	1.35	1.8	1.35	1.54	3.49	1.51	11.6	32.4	21.2
Stolen Property	23	17	18	0.35	0.67	0.97	-0.96	-0.42	0.28	9.6	22.2	31.8
Fraud	24	24	24	0.05	0.21	0.28	-1.06	-0.82	-0.72	7.7	8.2	13.6
Total Offenses	22	21	18	0.25	0.14	0.63	-0.99	-1.13	-0.63	14.6	14.9	16.0

Source: Steffensmeier, Allan, Harer, and Streifel (1989)

Note: the shading numbers indicate that the changes are toward the expected direction.

Chapter 4

Time-Series Analysis

This chapter examines two specific questions. First, does the relative difference in crime rates of youth (ages 12-17) and adults (ages 18-49) in Taiwan change over time? Second, if the difference reduces (youth crime involvement increases), is it due to the Taiwan socioeconomic development within this period? Augmented Dickey-Fuller tests are applied to explore the first question; annual time-series regression methods are used to examine the second question.

Augmented Dickey-Fuller Tests

With development, have the Taiwan age-crime distributions become more concentrated among youth? Chapter 3 explored this question using PAI at three time points: 1961, 1976 and 1991. The results suggest that the curves for the property offenses shift somewhat toward greater youth involvement, whereas there is little change in the age distribution of violent offenses. Is this finding still true if we analyze data based on all the available years? I apply Augmented Dickey-Fuller tests to examine this issue.

We have limited information on arrests and base population numbers by individual ages for all the years. Therefore, in this part of the analysis, I only use two age groups—juvenile (ages 12-17) and active adults (ages 18-49). For purposes of the time series tests, the present study uses the log ratio of youth crime rates versus adult crime

rates as the crime measure. This log variable has some unique statistical advantages, such as isolating noise from outliers and indicating a relative instead of absolute difference between youth and adults (see details in Chapter 3). Studies running Augmented Dickey-Fuller tests usually apply this log measure instead of PAI or crude crime rates (O'Brien 1999).

Before calculating the log ratio, one should notice that the adult age group contains more individual ages than the juvenile age group. Therefore, to estimate the youth-to-adult ratio appropriately, this study makes a robust adjustment for both youth arrest rates and adult rates by multiplying the original rates with the number of ages in the youth/adult age interval. Specifically, the formulas are below:

Adjusted Youth Arrest Rates= 6 * $Rate_{1217}$

Adjusted Adult Rates=12*$Rate_{1829}$+ 10*$Rate_{3039}$+10*$Rate_{4049}$[17]

Besides this adjustment, a major change in this part of analysis is that the base years taken into account becomes 1966-1991. The reason is that instead of 12-17, the juvenile age category in 1963-1965 Taiwan Arrest Statistics was 12-18, which was

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[17] The adult group of ages18-49 in fact is separated into four subgroups in Taiwan Arrest Statistics: 18-19, 20-29, 30-39, and 30-49. For some years (see Appendix I), the subgroups are 18-20, 21-30, 31-40, and 41-49. As discussed in Chapter 2, there is little difference between group 31-40 and group 30-39, and between 41-50 and 40-49. But it does have great differences between group 18-20 and group 18-19 since this age interval only contains two or three individual ages. To deal with this problem, the present study combines the groups of 18-19 and 20-29.

Instead of considering the 18-49 ages as a single group (32 times the overall rates for ages 18-49), the final adjusted adult crime rates are based on the three subgroups. That is because the crime rates vary within the group of ages 18-49. For instance, in 1991, the crime rate of ages 18-29 for larceny was 214.18, while the rate of ages 40-49 was 96.84. If we consider all adults in one single group, the rate of ages 18-49 turned to be 168.67 (see Appendix D). Thus, making adjustment based on rates of subgroups is more appropriate.

inconsistent with the other years and may induce bias in the estimation of proportionate youth crime involvement. Thus, I include data before 1966.

Appendix D lists the unadjusted juvenile arrest rates and unadjusted adult arrest rates (across different subgroups), whereas Appendix E reports the adjusted juvenile rates, adjusted adult rates and their ratios for all years (1966-1991). Table 4.1 summarizes Appendix E by displaying adjusted crime rates, ratios and PAIs across offense types for years 1966-1968, 1976-1978, and 1989-1991 (to take a three-year average).

The key findings derived from the column 1-6 (adjusted youth and adult crime rates) of Table 4.1 are the followings. First, for both youth and adults, larceny rates dropped during the period of 1966-1976 (adults dropped greater than juveniles) and then increased in the period of 1976-1991 (juveniles increased greater than adults). Second, adult crime rates for stolen property and fraud decreased from 1966 to 1976 to 1991, whereas youth crime rates for fraud were relatively stable and youth crime rates for stolen property kept increasing during these years. Third, youth crime rates for homicide and aggravated assault were either quite stable or kept declining; adult crime rates for these two offenses also showed a decreasing trend over time. Fourth, for both youth and adults, the arrest rates for robbery were relatively stable in the earlier development period and then jumped greatly in the late development period. Finally, for total offenses, adult rates showed an increasing trend, especially in the late development period, whereas youth rates dropped a little bit in the earlier development period and then increased substantially in the late development period.

Column 7-9 of Table 4.1 reports the ratio of adjusted youth-to-adult crime rates in years 1966, 1976 and 1991, indicating the relative difference between adjusted youth

rates and adjusted adult crime rates. These figures reveal that (1) the ratio between youth and adult crime rates for larceny and stolen property have increased continually and greatly during the 1966-1991 time period, indicating that youth involvement in these two offenses are increased relative to adult involvement (e.g. one youth involvement in stolen property is corresponding to 1.9 adult offending in 1991); (2) for robbery, fraud and total offenses, the difference between youth and adult rates increased in the earlier development period, whereas in the late development period, the youth-to-adult difference decreased, either because adult involvement declined (fraud) or adult involvement increased smaller than juvenile involvement (robbery and total); (3) the ratio is relatively stable for assaults since both youth and adult committed less assaults over time; (4) the variation of the ratio (jumped first and then decreased) for homicide was mainly driven by decreasing adult rates; (5) in Taiwan, across all offense types, the level of youth offending was still smaller than the level of adult offending, with larceny having the highest youth-to-adult ratio (1:1.3).

The above findings are consistent with the results discussed in Chapter 3: in Taiwan, the age-crime distributions for property crimes (except fraud) basically follow the development hypothesis (with development, youth are more likely to commit crime and the age-crime distributions thus shift to a younger distribution), whereas the age-crime distributions for violent offenses and total offenses vary differently. The findings on fraud seem contrary to conclusions of Chapter 3. However, it may be because the age-crime distribution for fraud in fact shifts to young adults (a group that this study did not examine) instead of concentrating among youth. Recall that the peak age of fraud moved from 29 in 1976 to 24 in 1971 (Table 3.1a). In general, fraud is a typical adult offense

(Steffensmeier et al. 1989) and that is why the youth involvement in fraud is relatively stable.

Column 10-12 displays the youth proportion of criminal offending among the total population of ages 12-49 (PAI), adjusting the annual changes of youth-to-adult age composition. These figures show similar trends as ratios.

Next, this study runs the Augmented Dickey-Fuller time series tests. The Augmented Dickey-Fuller test is an advanced time-series method designed to more clearly examine whether a series has a statistically significant trend over time, after taking into account random fluctuations/shocks and autocorrelations in that series (see Steffensmeier, Schwartz, Zhong and Akerman 2005; LaFree and Drass 2002; Britt 2001; O'Brien 1999; Hamilton 1994). The current study applies this ADF test to ascertain whether there is a statistically significant pattern in the youth-to-adult trends during the three decades in Taiwan[18]. Series are tested separately by types of offenses and for total offenses.

To alleviate random fluctuations and shocks of the data to establish a "stationary" series so that the directionality of crime trends is assessable, unit root tests are conducted to detect whether the youth-to-adult ratio wanders from a mean level (once moving away from that level, it will never return) over time. When the series needs a unit root, I first-difference the series to check the intercept. If the intercept is significantly positive, youth crime rates and adult crime rates are converged (the youth crime involvement is increased

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[18] Appendix E shows that for almost all offenses, the youth-to-adult ratios showed a decreasing trend after 1989. This may blur our views on the trends of the whole period. Therefore, the final ADF tests excluded years 1990 and 1991.

relative to adults); if negative, diverged (the youth crime involvement is decreased relative to adults); if not significant, trendless. No unit root needed means that for this specific offense, the youth and adult crime rates differ randomly around a mean value over time. In other words, the differences between them would be stable. In this process, I also examine how many lagged differences are required to delete autocorrelation of this series.

Based on my first-step test results, except for assault, the time series for the other offenses all need to be first differenced. Moreover, all the series in this table have zero lagged difference, indicating that autocorrelation is not a concern after first-difference.

Table 4.2 presents the final results from the Augmented Dickey-Fuller tests, where the intercept (alpha) stands for the direction and magnitude of the time trend. The trends for stolen property and larceny are all positive and statistically significant, indicating that the youth-to-adult differences in arrests for these two offenses have indeed reduced.

During the same period, the youth-to-adult differences in Taiwan arrests for homicide, robbery, and fraud are trendless (nonsignificant alpha). The series for assault do not need a unit root; further, the separate youth and adult trends are subject to the same shocks and fluctuations over time (same number of differences). Cointegration thus has been established for assault. In other words, juvenile and adult assault rates are moving in tandem with each other so that the age difference holds stable over time. Recall that Table 4.1 shows similar findings: both youth and adult assault rates decreased in roughly parallel fashion during these three decades.

Taken together Table 4.1 and Table 4.2, I get very similar results to the findings of my descriptive analysis in Chapter 3 and also provide some explanations for those findings: for property offenses (except fraud), the youth-to-adult differences kept declining due to the increasing (more rapidly than adults) youth crime involvement over time; for total offenses and robbery, the youth-to-adult differences did not have significant changes over time because youth crime involvement decreased at the beginning and then increased (counteracting the total trend); the changes of youth-to-adult differences for homicide and fraud in fact are driven by the decreasing adult rates; for assaults, the crime involvement of youth and adults shifted toward the same direction so that the age differences overall did not show a significant change. That is, the time-series tests further support that the Taiwan age-crime distributions for larceny and stolen property consistently varied toward the expected direction—they shifted to younger age, whereas the distributions for violent offenses and total offenses did not show such shifts over time. Fraud may show similar trends as larceny and stolen property. But due to the nature of this offense, the shift of its age-crime curve can only be toward younger adults instead of juveniles, which is not the focus of this study.

Annual Time-Series Regression Models

The previous analysis suggests that for larceny and stolen property (but not violent offenses), the age-crime relationship shifts toward a younger distribution with the development of Taiwan society. Thus, it is necessary to run regression models for larceny and stolen property to explore the socioeconomic factors driving the variation of the age-

crime curves. Following the ADF tests, the log ratio of adjusted youth-to-adult crime rates is used as the dependent variable in each of the two regression models. As explained in Chapter 2, it is appropriate to add only the endogenous variables into the ADF equations. The results of the ADF tests have told us that the time-series models for the three types of property offenses need a first-order error structure (AR(1)) and no lagged difference is required once we first-difference the equation (time effects have been controlled).

As for the independent and control variables, Chapter 2 has described their definitions and operationalizations (see Table 2.1). Development is measured in two ways: GDP per capita as a key indicator of pure economic development versus Human Development Index as a composite indicator of socioeconomic development. The control variables are growth rate of GDP per capita, Gini index, unemployment, percent of urban population, percent of juvenile population, divorce rate, and police case clearance rate. Growth rate of GDP per capita measures the speed of Taiwan economic development during these three decades; Gini and unemployment rate are used here as indicators of changes in economic inequality over the 1966-1991 period; percentage of urban population, percentage of youth and divorce rate are proxy measures of changes in social control and crime opportunities accompanying with development; case clearance rate is a measure on the effectiveness of police performance in Taiwan.

I list their values in Appendix F. Table 4.3 summarizes the descriptive statistics for them. Based on Appendix F and Table 4.3, we can get a general view of these

predictors. Among all these variables[19], GDP per capita, Human Development Index (HDI), percentage of urban population, and divorce rate have increased steadily from 1966 to 1991. HDI in Taiwan has increased from 0.510 in 1966 to 0.823 in 1991[20]. Similar trends are found for GDP per capita. The percentage of urban population in Taiwan has increased from 31.0% in 1966 to 55.5% in 1991 (almost double). Except for a brief decline in 1960s, the divorce rate has increased from 0.38% to 1.38%. Both Gini index and unemployment rate have decreased during this period, although not very consistently. The Gini index has dropped from 32.43 to 30.49 and the unemployment rate has declined from 3.02% to 1.51%, indicating that the inequality level in Taiwan keeps decreasing. All the other variables show little variation or the variation that exists is random. But based on previous theories and literature (see details in Chapter 2), I decide to keep them in the models.

Testing for Multicollinearity

Multicollinearity means that within the set of independent variables, some of them are nearly or totally predicted by the others. When multicollinearity problem appears, some of the independent variables are highly correlated so that the parameter estimates in a multivariate regression model may be unstable and biased (Geary and Leser 1968; Blalock 1972; Bertrand and Holder 1988; Largey and Spencer 1996). This study thus

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[19] Some of these variables have missing values (but only a few). That is because the data on that year is unavailable (Taiwan Statistical Yearbook or the World Income Inequality Database do not report them).
[20] Please notice that HDI is an index from 0 to 1. The higher value of HDI has, the more developed the society is.

conducts a test for multicolinearity using the VIF variance inflation factors (VIFs). In the models using GDP per capita as the measure of development, the VIF tests show that percent urban population, percent ages 12-17, and divorce rate are highly correlated with GDP per capita. Similar results are found in the models using HDI (see correlation matrix in Appendix G). For example, the bivariate correlation coefficient between percent youth and HDI is -.940. Scholars usually hold that a VIF value of over ten indicates that the presence of multicollinearity (Neter, Wasserman, and Kutner 1990). In all models, the VIF values of percent urban, percent youth, and divorce rate are more than 20, implying a serious multicollinearity problem.

Fox (1991) suggests that to deal with collinearity, we can either reduce the independent variables or combine some of them. Thus, the present study tries to deal with it in two ways. The first effort is to combine percent urban population, percent youth, and divorce rate to form an index of social control/crime opportunities. This index has a relatively strong internal consistency since its reliability measure is around .60. The VIF value of this index turns to be around 11, which is still over 10. The second effort is to include only one variable of the three into the model. Since the percent urban has a clear increasing trend and greater variation than the other two variables (see Appendix F), I select percent urban as the left variable. Unfortunately, the VIF value of percent urban is also more than 10.

Prior literature has found that with development/modernization, a society tends to be more urbanized, with more divorces, and toward an aging population structure (see a review in Harrell 1994). Therefore, regression models with measures on the level of development, to great extent, have accounted for the changes of urbanization, family

structure and population composition. To avoid multicollinearity problem completely, the final regression models in this study therefore exclude the three variables. The "percent urban population" and "urban-divorce-youth index" are examined in my supplemental analysis.

As an example, in Table 4.4 I show the VIFs associated with each independent variable for larceny offense across different development models. All of them are no more than 3, which is far below 10. Table 4.4 also includes a correlation matrix for the larceny models. None of the bivariate correlations between the independent variables exceed .70, a traditional standard "cut-off" point indicating when multicollinearity may be present (Hanushek and Jackson 1977). Similar results appear in models for stolen property.

Results of the Regression Analysis

Table 4.5 reports the regression results for our analysis on the relationship between development and the log difference of adjusted youth and adult crime rates for larceny and stolen property, net of controls. Column 1-2 present the results of the two separate models for each property offense (larceny and stolen property) using GDP per capita as an indicator of development. Column 3-4 present the results of the two separate models for each property offense using HDI as an indicator of development. Growth rate, Gini index, unemployment rate, and case clearance rate are controlled in these models.

The standardized coefficients of predicators and their t statistics are listed in Table 4.5. If a coefficient is positive, higher values for a particular independent variable are

associated with higher youth-to-adult differences, or vice versa. For example, in the GDP model for larceny offenses, a one-unit increase in the value of GDP per capita is associated with .206 unit increase in the log ratio of youth-to-adult larceny rates. Since this is a first-order autoregression model, the estimates of autocorrelation coefficients (Rho) and their standard errors are also reported in the table.

All models indicate a significantly positive relationship between development and youth-to-adult differences for both types of property offenses, no matter how the level of development is measured. This means that the higher the HDI or the GDP per capita, the bigger the log ratio of youth-to-adult property crime rates. In other words, the level of development increases the youth property crime involvement relative to adults. The effects of development in HDI models are a little bit higher than in GDP models across the two property offenses, for example, .585 in GDP model for stolen property versus .890 in HDI model for the same offenses. This might be due to HDI is a more composite measure on development instead of pure economic development. For example, HDI contains measures on education level,

As for the control variables, in both the GDP model and the HDI model, the case clearance rate and unemployment level have significantly negative effects on the youth-to-adult larceny differences, indicating that the higher the unemployment rate and the more effective the police performance, the larger the difference between youth and adult arrest rates for larceny. In contrast, the Gini index significantly increased the ratio of youth-to-adult crime rates, indicating that the higher the income inequality, the greater youth crime involvement relative to adults. The growth rate measure is not significant in the models for larceny. Except the development measure, all control variables, including

growth rate, unemployment rate, clearance rate, and Gini, are not significant in the models for stolen property.

Overall, the results of this annual time series analysis are consistent with the predictions from the variancy approach about the possible impacts of development on the age-crime distributions. That is, for both types of property offenses, the higher the level of development, the greater relative youth crime involvement. Measures on other macro social situations, including economic growth rate, unemployment, and the clearance rate have nonsignificant, weaker or even opposite effects on the relative youth involvement for property offenses. Although Gini index shows similar positive effects on the youth-to-adult ratio as the measure of development in the model for larceny, it is not significant for stolen property. Hypothesis 4 thus receives strong support for property offenses: development contributes to increased proportionate youth crime involvement.

Supplemental Analyses

To exhaust more fully the evidence on the relationships between development and the age-crime distribution in Taiwan, I run three supplemental analyses: regression models directly on youth crime rates and adult crime rates, regressions on fraud, violent offenses and total offenses, and regressions with the percent urban population and the urban-youth-divorce index.

Since the log ratio of youth-to-adult crime rates contain two factors—both adult crime rates and youth crime rates, it is likely that the changes in adult crime rates are contributing to the change of age-crime distributions instead of the increased youth crime

rates. Therefore, I run a regression model directly using the youth crime rates and the adult crime rates as the dependent variables. Table 4.5 has indicated that both GDP per capita and HDI can be used as the key indicator of development and the results of the regressions are only slightly different for the two models. Thus, in this supplemental analysis, I only use GDP per capita to measure the level of development, assuming that HDI can generate similar results. If the series of arrest rates do not need a first-differenced error structure, I run an OLS model with time and time square as controls (see similar methods in Sivarajasingam, Shepherd, Matthews and Sally Jones 2002; Steffensmeier et al. 2005).

The first two columns of Table 4.6 report the results of juvenile analysis for larceny and stolen property, whereas the first two columns of Table 4.7 display the results of adult analysis for the two offenses. Consistent with Table 4.5, there is a significantly positive relationship between development and youth crime rates for larceny and stolen property offenses, showing that development directly increases youth crime rates—which also, therefore, leads to a reduction of the youth-to-adult differences for these two offenses. In contrast, development only has positive effects on the adult rates for larceny but not for stolen property.

Examining the models for larceny, different from Table 4.5, the negative effects of unemployment lose significance when the dependent variable becomes a direct measure of youth crime, while the unemployment rates have significantly positive effects (.505) on adult rates for larceny. The Growth rate of GDP per capita significantly increases the juvenile rates for larceny (.366), whereas it is insignificant in the adult model. Gini coefficients become nonsignificant in models for both juveniles and adults,

indicating that Gini only has effects on the ratio and is not a direct causal factor of the youth or adult crime involvement.

As for stolen property, different from Table 4.5, the unemployment rate (.372), growth rate (.468), clearance rate (.265), and Gini (-.208) all have significant effects on juvenile crime rates for stolen property, when the effects of economic development has been considered. The growth rate (speed of development) is also significant (.228) when predicting adult crime rates for stolen property. One interesting finding is that for stolen property, although the youth crime rates increase with development, the adult crime rates are not significantly associated with time or even decrease over time. This is consistent with findings in Table 4.1.

The descriptive analysis in Chapter 3 and ADF analysis in this Chapter both reflect that the effects of development on violent offenses and total offenses seem not significant or contrary to the expected direction. Fraud also shows a distinctive trend: no significant shifts to youth but tend to peak earlier among young adults. To get further evidence, the second supplemental analysis deals with fraud, violent offenses, and total offenses. Simply following the first supplemental analysis, I use the same series of independent and control variables to directly predict the youth crime rates for these offenses. The latter five columns of Table 4.6 and Table 4.7 list the results. Consistent with previous findings, the level of development does not have significantly positive effects on youth crime rates for fraud, homicide, assault and total offenses. The coefficient of GDP per capita in the model for robbery is significantly positive (the standardized coefficient in the OLS model is 2.254). Similar effects are found in the model predicting adult crime rates. This may be because robbery shares some nature with

property offenses (for fulfilling economic benefits). However, since both of them are negatively related with time (other social factors may contribute to this), the ratio of youth-to-adult crime rates and the overall age-distribution may not show a clear and consistent change toward younger concentration over time.

As for the control variables, the clearance rate is negatively associated with fraud (only for youth) and robbery (for both youth and adult crime rates), while it is positively related to adult total crime rates. The economic growth rate has positive effects on total crime rates for adults and assault rates for both juveniles and adults, whereas Gini index has negative effects on adult assault rates and adult homicide rates. One interesting finding is that the no factors are significant in the models for juvenile homicide, juvenile total, and adult fraud, implying that they may be driven by different social factors. Also, time in the adult model for homicide and in the juvenile model for total offenses seem having curlinear effects.

Many previous aggregate-level studies on crime put development, urbanization, family disruption, and age structure in one model (e.g. Roberts and LaFree 2004; Messner 1989). Morevoer, some statisticians like to argue that collinearity is not an important concern and we can just "lump" it, but cautiously (Stapleton 1995). The last supplemental analysis, thus, is to add the percent urban population into the models in Table 4.5 so that we can get a better sense of the effects of multicollinearity problems. If collinearity is not a problem, the percent urban population should be kept in the model. As a result, Table 4.8 shows that once the percent urban population is introduced, the level of development turns to be negative in the model for larceny and its effect becomes

much weaker in the model for stolen property[21]. In a word, the collinearity problem in this model creates serious ambiguity in the interpretation of the regression coefficients because they are not appropriately estimated. Therefore, we should exclude this index from the regression analysis. That is, in Taiwan, urbanization, divorce rate and percent youth are highly correlated with the level of development mostly.

Summary

In this chapter, I first examined the trends of the youth-to-adult ratio by different types of offenses. The results of Augmented Dickey-Fuller tests reflect that only for property offenses (except fraud, a typical crime for adults), the trend is upward (juvenile crime involvement are increased relative to adults). This finding is consistent with the results from my descriptive analysis in Chapter 3 and then provides further evidence for Hypothesis I (the age-crime curves shifts to younger distribution). Also similar to the findings reported in Chapter 3, my tabular and ADF analysis on the crime rates and log ratio series for youth and adults reveal that the shifts of the age-crime distributions for violent offenses and total offenses are contrary to Hypothesis I. Specifically, the youth involvement for robbery and total offenses decreased in the earlier development period and then jumped thereafter, while at the same time the adult involvement for robbery and total offenses kept increasing; the youth involvement for homicide increased a little bit in at earlier time and then returned to the old level, whereas the adult involvement for homicide dropped greatly in the earlier period and then kept stable; the youth

[21] I also try models with the urban-divorce-youth index and get similar results.

involvement for assault is moving together with the adult involvement, which makes the shifts of the overall age-crime distributions difficult to detect. These findings got further support in my second supplemental analysis. Therefore, the process of development appears to have only small or negligible effects on the shifts of age-crime distributions for fraud, violent offenses and total offenses in Taiwan and other social forces need to be explored.

Next, using the log ratio of youth-to-adult crime rates for larceny and stolen property as the dependent variable, I examined the research question whether development contributes to such variation (Hypothesis 4). As discussed in Chapter 1, criminologists holding the variancy positions (e.g. Steffensmeier et al. 1989; Greenberg 1985) and scholars on the relationship between development and youth life (e.g. Mortimer and Larson 2002) believe that development tends to increase the role strain and economic marginality of youth and thus contribute to more youth involvement in crime and delinquency. Such an argument receives considerable support in this study. The results of annual time-series regression analysis show that development in Taiwan has the expected effects on the age-crime distributions in terms of general property offenses. That is, the economic development (measured by GDP per capita) is likely to increase youth crime involvement compared to adults; the HDI models further indicate that besides economic development, other aspects of development can strengthen the criminogenic social situations around youth. For example, the extended education makes youth more alienated from the adult world and closer to peer groups (i.e. Anderson 2002).

The next chapter summarizes the key findings of the entire study. The theoretical and methodological implications of this research, caveats of the project, and avenues for future research will also be discussed.

Table 4.1: Summary of Taiwan Arrests for Juveniles and Adults by Offense Categories in 1966-1968, 1976-1978, and 1989-1991

	Adjusted Youth Rates [a]			Adjusted Adult Rates [b]			Ratio of Youth-to-Adult Rates [c]			Juvenile Proportion [d]		
	1	2	3	4	5	6	7	8	9	10	11	12
Offenses	**1966**	**1976**	**1991**	**1966**	**1976**	**1991**	**1966**	**1976**	**1991**	**1966**	**1976**	**1991**
Violent:												
Homicide	98.2	110.6	96.2	715.6	437.5	465.3	1：7.3	1：4.0	1：4.7	12.0	20.2	17.2
Assault	165.7	144.0	102.6	1621.0	1266.6	1170.3	1：9.8	1：8.7	1：11.5	9.2	10.3	8.0
Robbery	45.7	37.6	302.7	102.4	112.1	718.0	1：2.2	1：3.0	1：2.4	31.0	25.1	28.6
Property:												
Larceny	1616.2	1040.0	3110.7	4445.7	2553.2	4219.5	1：2.7	1：2.5	1：1.3	26.8	28.9	42.6
Stolen Property	32.7	52.2	148.3	773.2	530.0	287.2	1：23.3	1：10.1	1：1.9	4.1	9.0	34.7
Fraud	13.9	9.0	11.0	616.7	556.2	207.6	1：45.5	1：58.8	1：18.9	2.2	1.6	5.0
Total Offenses	2202.6	1799.7	5521.8	12169.7	12403.9	23123.7	1：5.5	1：6.8	1：4.0	15.4	12.7	19.7

a. Adjusted Youth Rates=Number of Ages (6) in the Age Interval * Youth (12-17) Rates per 100,000.
b. Adjusted Adult Rates=Number of Ages (12) in the Age Interval * Rates per 100,000 for Adult Subgroup I (18-29)+
Number of Ages (10) in the Age Interval * Rates per 100,000 for Adult Subgroup II (30-39)+
Number of Ages (10) in the Age Interval * Rates per 100,000 for Adult Subgroup III (40-49).
c. Ratio=100% * Adjusted Youth Rates / Adjusted Adult Rates.
d. Proportion=100%*Adjusted Youth Rates / (Adjusted Youth Rates + Adjusted Adult Rates)

Table 4.2: Results from Augmented Dickey-Fuller Tests [a] Based on a Series of Differences between the Logged Adjusted Arrest Rates for Youth (12-17) & Adults (18-49) in Taiwan, 1966-1989 [b]

Offenses	Estimated Value (α) [c]	Trend [d]
Violent:		
Homicide	.0532	Trendless
Assault	------	Stable
Robbery	.0185	Trendless
Property:		
Larceny	.0362*	Convergence
Stolen Property	.1604***	Convergence
Fraud	.0682	Trendless
Total Offenses	.0191	Trendless

a. The Augmented Dickey-Fuller first differenced equation tested here is based on the following specification: $y_t - y_{t-1} = \alpha + \delta 1(y_{t-1} - y_{t-2}) + \delta 2(y_{t-2} - y_{t-3}) + \ldots + \mu t$, where equations contain zero, one, or two difference terms, depending upon the number needed to eliminate autocorrelation. In this table, all series have zero lagged difference.

b. The ratios for almost all offenses in 1990 and 1991 showed a decreasing trend (see Appendix D). This may blur our views on the trend of the whole period. Therefore, the ADF tests only focus on the years between 1966 and 1989.

c. Significance levels (two-tailed tests): *p<.10 **<.05 ***<.10; the significance of the larceny series is almost equal to .10 (marked with @) and I consider it significant due to the short time period (from 1961 to 1991, only 30 time points).

d. If the series do not need a unit root, youth and adult series randomly differ around a mean value across time (*stable*); if the estimated statistic (α) is not significant, the gap between youth and adult arrest involvement is *trendless*; if α is significantly positive, the two series show a *convergence*; if α is significantly negative, the two series show a *divergence*.

Table 4.3 Descriptive Statistics for Predictors Included in the Analysis (N=26)

Predictors	Minimum	Maximum	Mean
GDP per capita	238	8769	2578.8
HDI	.510	.823	.676
Growth Rate	-1.1	33.3	15.5
Gini	27.7	33.6	29.5
Unemployment	1.23	3.02	1.9
% Urban	31.0	55.5	45.5
% Youth	11.0	15.6	13.4
Divorce Rate	.4	1.4	.7
Clearance Rate	73.8	89.2	83.3

Table 4.4 Variance Inflation Factors and Correlations for Larceny across Different Development Models

VIF Values

Predictors	GDP Model	HDI Model
GDP per capita/HDI	2.120	1.648
Growth Rate	1.509	1.476
Gini	1.102	1.185
Unemployment	1.624	1.533
Clearance Rate	2.092	1.665

Correlation Matrix

Variables	Y	X1	X2	X3	X4	X5
(Y) Log Ratio of Youth-to-Adult Larceny Rates	1	.798**	.145	-.041	-.189	-.737**
(X1) GDP per capita		1	-.036	.081	-.083	-.606**
(X2) Growth Rate			1	.063	-.541*	.040
(X3) Gini				1	.194	-.121
(X4) Unemployment					1	-.075
(X5) Clearance Rate						1

Variables	Y	X1	X2	X3	X4	X5
(Y) Log Ratio of Youth-to-Adult Larceny Rates	1	.803**	.145	-.041	-.189	-.737**
(X1) HDI		1	.004	-.165	-.060	-.583**
(X2) Growth Rate			1	.063	-.541**	.040
(X3) Gini				1	.194	-.121
(X4) Unemployment					1	-.075
(X5) Clearance Rate						1

Table 4.5 Annual Time Series Results: Effects of Development on Youth-to-Adult Property Crime Involvement Ratio in Taiwan, 1966-1991

	GDP Models		HDI Models	
Independent Variables	Larceny	Stolen Property	Larceny	Stolen Property
GDP per Capita/HDI	.206*	.585***	.432***	.890***
	(1.118)	(3.157)	(2.634)	(10.140)
Growth Rate	.103	.105	.103	.051
	(.440)	(.444)	(.508)	(.524)
Gini Coefficient	.317**	-.151	.291**	-.022
	(1.738)	(-.824)	(1.808)	(-.275
Unemployment Rate	-.493**	-.056	-.394**	.014
	(-2.032)	(-.229)	(-1.884)	(.142)
Clearance Rate	-.393**	-.103	-.361**	-.106
	(-2.045)	(-.116)	(-2.103)	(-1.197)
First Order Autoregressive	.821**	.839**	.695**	.398*
Error Term (AR (1))	(.131)	(.125)	(.165)	(.210)

* p<.10 ** p<.05 *** p<.01 (two-tailed tests)

Table 4.6 Time Series Results: Effects of Development on Youth Crime Rates in Taiwan, 1966-1991

	AR(1)		OLS Model (time and time square as controls)				
Independent Variables	Larceny	Stolen Property	Fraud	Homicide	Assault	Robbery	Total
GDP per capita	.735***	.734***	-.514	-1.382	-.585	2.254**	-.143
	(5.363)	(4.589)	(-.228)	(-.529)	(-.243)	(1.679)	(-.198)
Growth Rate	.366**	.468**	.205	-.100	.402*	.108	.144
	(2.543)	(2.482)	(.863)	(-.361)	(1.577)	(.759)	(1.882)
Gini Coefficient	.106	-.208*	.236	-.053	-.229	.034	.011
	(.877)	(-1.359)	(1.011)	(-.196)	(-.918)	(.248)	(.142)
Unemployment Rate	.185	.372**	.249	-.543	-.052	.234	-.108
	(1.218)	(1.880)	(.572)	(-1.076)	(-.111)	(.901)	(-.773)
Clearance Rate	-.175	.265*	-.561**	-.104	-.297	-.430***	.078
	(-1.273)	(1.611)	(-2.096)	(-.333)	(-1.035)	(-2.689)	(.902)
First Order Autoregressive	.380*	.586**					
Error Term (AR (1))	.212	.186					
Time			-.125	1.026	-.031	-1.611*	.980*
			(-.060)	(.421)	(.989)	(-1.285)	(1.447)
Time Square			.085	.240	.387	-.627	.638***
			(.095)	(.231)	(-.403)	(-1.170)	(2.205)

* p<.10 ** p<.05 *** p<.01 (two-tailed tests)

Table 4.7 Time Series Results: Effects of Development on Adult Crime Rates in Taiwan, 1966-1991

	AR(1)	OLS Model (time and time square as controls)					
Independent Variables	Larceny	Stolen Property	Fraud	Homicide	Assault	Robbery	Total
GDP per capita	.427**	.626	.658	-1.580	1.165	1.849**	1.448
	(1.896)	(.403)	(.296)	(-1.135)	(.523)	(2.496)	(.963)
Growth Rate	.316	.228*	.159	-.124	.491**	.031	.281**
	(1.290)	(1.386)	(.674)	(-.839)	(2.085)	(.401)	(1.771)
Gini Coefficient	.102	.038	-.131	-.308***	-.324*	-.002	-.067
	(.500)	(.235)	(-.567)	(-2.133)	(-1.404)	(-.021)	(-.432)
Unemployment Rate	.505**	.292	.173	-.307	.299	.177	.175
	(1.958)	(.971)	(.403)	(-1.140)	(.694)	(1.236)	(.603)
Clearance Rate	.140	.160	.096	-.091	-.277	-.191***	.286*
	(.545)	(.863)	(.361)	(-.547)	(-1.045)	(-2.167)	(1.600)
First Order Autoregressive	.434**						
Error Term (AR (1))	.207						
Time		-1.279	-1.192	.677	-1.562	-.955*	-.530
		(-.882)	(-.573)	(.520)	(-.751)	(-1.379)	(.378)
Time Square		.284	-.315	1.204***	.035	-.374	.137
		(-.457)	(-.355)	(2.166)	(.039)	(-1.265)	(.228)

* p<.10 ** p<.05 *** p<.01 (two-tailed tests)

Table 4.8 Annual Time Series Results: Effects of Development on Youth-to-Adult Property Crime Involvement Ratio in Taiwan 1961-1991, Controlling for percent of Urban Population

Independent Variables	Larceny	Stolen Property
GDP per capita	−. 058	.259*
	(-.216)	(1.499)
% Urban Population	.483**	.676***
	(1.779)	(4.102)
Growth Rate	.133	.079
	(.638)	(.820)
Gini Coefficient	.309**	-.067
	(1.822)	(-.763)
Unemployment Rate	-.378*	.074
	(-1.726)	(.725)
Clearance Rate	-.358**	-.074
	(-2.031)	(-.798)

* p<.10 ** p<.05 *** p<.01 (two-tailed tests)

Chapter 5

Discussion and Conclusion

Discussion

Although scholars agree that crime tends to rise and peak in adolescence or early adulthood and decline afterwards, there is a contentious debate in the criminological literature about whether the *shape or form* of the age-crime relationship is invariant (called the *invariancy* position) or variant (called the *variancy* position) across all social and cultural conditions and all social groups at all times. The present study addresses what is perhaps the central element in this debate – the impact of *development or modernization* on the age-crime relationship, using 1961-1991 crime data from *Taiwan*, a nation that has undergone considerable development over the past several decades and, in fact, has moved from being classified as a *developing or pre-industrialized* nation to a *developed or industrialized* nation. At issue is whether Taiwan's age-crime curve has shifted to a younger age distribution over this time period as predicted by the *variancy* position or whether Taiwan's age-crime curve remains essentially unchanged despite the forces of development as predicted by the *invariancy position*. Descriptive techniques and advanced time-series analysis are applied to examine these questions. The age-crime distributions in the United States are also used for comparison.

Major Findings

I review here the findings pertaining to each of the hypotheses articulated in Chapter 1.

Hypothesis I: Due to differences of the development level, the age-crime curve in Taiwan is not stable across different time periods, controlling for different offense types: the curve in the post-developed period will have a lower peak age and sharper declines thereafter, than in the pre-developed period;

For offenses of larceny and stolen property, both the descriptive analysis on the age-crime curves and time series tests on the log ratio of youth-to-adult crime rates show considerable support for this hypothesis. That is, with development, the peak ages of these two age-crime curves descend; the distributions become more skewed to the right (more concentrated among youth); the general shape turns to be more peaked (sharper declines after peak ages); the youth involvement is increased relative to adults.

In contrast, for violent offenses and total offenses, the results of my analysis do not reflect such changes. The age-crime curves for these offenses in fact shift toward another direction: peaked at later ages, more like a bimodal distribution, more dispersed, and less concentrated among youth. Although the descriptive analysis documents that the peak age (but still in 20s) of the age-crime curve for fraud became much earlier in 1991 than in 1976, the distribution seems less concentrated over time. The time series tests also do not find evidence of greater proportionate involvement of youth in fraud crimes. In general, fraud is still a typical adult crime and even tends to be more dispersed across the subgroups of adults.

Hypothesis II: Due to the same reason, the general shape of the age-crime distributions in Taiwan may be similar to those in the United States at relatively equal development levels. Specifically, the age-crime distributions in both Taiwan and the US in the post-developed period will look like an inverted "J"; during the modernizing process, the direction of changes in the age-crime distribution for both societies is toward greater youth concentration in criminal offending and younger peak points.

This hypothesis only receives support for offenses of larceny and stolen property. Specifically, both in Taiwan and in the United States, during the process of modernization, the age-crime curves for these two types of offenses shift toward greater youth concentration in criminal offending and younger peak ages; in the post-developed period, the Taiwan curve for property index and the U.S. curve for property index are very similar.

Hypothesis III: There should be certain differences when we compare the age-crime distributions in Taiwan with those in the United States, due to the cultural differences: Compared to the U.S., across all time periods, the population-adjusted percentage of youth arrested in Taiwan will be smaller, the peak age will be later, and drop off rates will be slower;

There are substantial differences when we compare the age-crime distributions in Taiwan with those in the United States, which implies strong support for this Hypothesis. Specifically, for violent crime index and total offenses, the Taiwan age-crime curves in the post-developed period are essentially bimodal, compared to the general unimodal shape in the United States. Also, for most types of offenses in the United States (except fraud is stable over time), the peak age keeps descending and the shape becomes

progressively more peaked over time. In contrast, the age trends in Taiwan have great variations across types of offenses and across time periods: some offenses tend to be less peaked over time (i.e. robbery); some shift toward younger distribution at earlier time and then become more dispersed in late period (i.e. homicide). All these differences indicate that the effects of development work differently across societies. Traditional Chinese societies, such as Taiwan, apparently have some distinctive characteristics that meliorate the positive relationship between development and youth crime involvement (especially for violent crimes and other nonproperty offenses).

Hypothesis IV: It is the impact of development that drives the changes of the Taiwan age-crime distribution by increasing the youth offending involvement. Such effects on the age-crime relationship, however, may be mitigated by cultural forces.

The results of annual time series regressions show considerable support for this hypothesis: for both larceny and stolen property, development has significantly positive effects on the adjusted ratio of youth-to-adult crime rates and pure youth crime rates. The level of development also has significant positive effects on youth and adult crime rates for robbery. This may be because robbery could be considered as a type of property crime since the aim of robbery usually is the same as larceny and stolen property (to satisfy financial needs).

In addition, the supplemental analysis reveals that development in Taiwan has small or negligible effects on proportionate youth offending for homicide, assault, and total offenses (containing other types of offenses, such as drug, public order and sexual offenses). This finding suggests some support for the last part of Hypothesis 4: certain

cultural forces may reduce or diminish the impact of development on youth crime involvement relative to adults, at least for violent offenses and other nonproperty offenses.

Explanations of the Findings

The above summarizes the major findings from my analysis. In general, the findings show substantial support for the variancy position that the age-crime distributions vary across time periods, societies, and types of offenses. Why this is the case? By extension, the findings also support the tendency derived from traditional criminological theories (i.e. strain theory, opportunity theory, social control theory, differential association theory, rational choice theory, and cognitive theory) that in different time periods and different places, people at different ages have different exposure to criminogenic factors so that the age-crime distributions vary.

It appears that development in Taiwan changes the nature of crime and produces more opportunities and motivations for general property crime (Steffensmeier 1993; Liu and Messner 2001). With development, there is an increasing supply of goods, self-service market, credit-based economy, and especially, consumerism. Youth are more likely to be attracted by consumerism, while at the same time, compared to adults, youth generally have limited access to legitimate means to meet their financial needs (Greenberg 1985). Even in the underworld, they have fewer opportunities to commit low-risk and high-yield offenses (Steffensmeier et al. 1989). Thus, minor property offenses, such as larceny and stolen property, become more and more popular among youth.

The findings also suggest that the importance of cultural effects when using modernization to predict youth crime/deviance (Zhang and Thomas 1994). On the one hand, Taiwan achieved modernization without the conventional process experienced by Western countries (a shorter history of urbanization and industrialization) and the traditional culture thus may not have changed very quickly. On the other hand, Confucianism with its emphasis on human relations and family cohesion is deeply rooted in Taiwan society and may be resistant to change even in the force of modernization. Some research suggests that same as before, youth in current Taiwan still have high conformity to parents and educators' expectations, value academic achievement, spend much more spare time on studying (compared to U.S. youth), participate in social and familial functions in the presence of adults, hold family-related values (i.e. filial piety), cherish interpersonal relationships, receive extensive care and supervision from adults, emphasize moral secularism, select peaceful strategies to deal with intergenerational conflicts (McBeath 1986; Ho 1989; Lau 1996; Cummings and Altbach 1997;Yuan and Shen 1998; Montgomery, Kuenning, and Mete 2000; Kuan 2004). Despite undeniable changes that have taken place (i.e. divorce rates increase, youth become more individualized and enjoy more autonomy, and peer culture emerge), traditional conceptions and values, however modified and disguised, continue to exert their influence on youth in present Taiwan. This traditionalism may help explain in particular why the Taiwan age-crime distributions for violent offenses (more related with interpersonal relationships and thus more likely to be affected by culture like Confucianism and familism) have not shifted toward greater youth involvement.

Implications of This Study

Sociology of Age. Besides implications for both crime theories and research on the age-crime association, the current study contributes to the sociology of age. Sociologists all agree that age is one of the dominant forms of social stratifications (Rider 1987). Sociology of age provides an analytical framework for understanding the interplay between human lives and changing social structures (Riley 1987). Specifically, its mission is to examine the interdependence between (1) aging as a social process and (2) societies and groups as stratified by age. By addressing process (development) and age group differences (age-specific crime involvement), this study is a representative example of this type of framework. Also, one important finding in this study is that crime involvements are not only shaped by age structure but also are shaped by other macrostructural factors like economic development and cultural adaptation. This three-level interdependency and the multidimensionality of sociological concerns show considerable support for the significance of age studies in sociology.

Sociology of Adolescence. The present project focuses in particular on the relationship between development and youth criminal offending, which has implications for the field of adolescence sociology. To some extent, this research helps to answer the contentious debate on whether social adolescence is a universal life stage and whether adolescence is a period of storm and stress so that problem behaviors are considered a normal part of adolescence. On the one hand, the results of this study support the view that to some degree, the problematic aspects of adolescence are due to rapid social change and acculturation — e.g. in the processes of urbanization, industrialization and

westernization. Development extends formal education, reduces job opportunities for youth, and encourages consumerism — factors that are likely to increase the role strain and marginality of youth that in turn, may lead to more youth crime/deviance involvement (see reviews in Steffensmeier and Ulmer 2002; Dasen 2000). On the other hand, scholars of adolescence and youth propose that societies that manage to keep traditional values (i.e. family solidarity) and culture identity can reduce the exacerbation of the problems of adolescence even in the face of social change (Brown et al. 2002).

The current study shows evidence for this approach: in Taiwan, although development contributes to the increasing relative youth involvement in larceny and stolen property, the traditional values that continue to hold in Taiwan apparently slow down this process and even counteract the effects of development on youth involvement in violent offenses and other types of offenses. Ho (1989) has argued that youth in Chinese societies could avoid turbulence and rebelliousness for several reasons. First, Chinese parents do not assume the existence of a youth world different from the adult world and Chinese children are not alienated from the adult world (except the sex area). Therefore, youth are permitted to stay up late (no stable bed-time) and be among adult company (familial, social, ceremonial, and even business activities). In this way, youth can enter into the adult world without abrupt shifts. Furthermore, Chinese societies tolerate prolonged dependency on parents beyond teen ages because both parents and children believe that parents will come to depend on children when they are old. Such mutual dependency means that there is no urgency for the young people to establish their independency.

Modernization/Development Research. One main aim of the present study is to explore the effects of modernization or development on the age-crime relationship. Social change, especially when brought on by industrialization and modernization, is a longstanding concern in Sociology. From Durkheim (1897) to Giddens (1991), almost all famous sociologists have interests in the positive/negative influences of modernization on various aspects of social life. Sociology in this century also has an increasing emphasis on how society operates and changes and how these changes are constructed through interactions and orientations of its members. From this point of view, by examining social changes in an Eastern society experiencing the full process of modernization within a short period, this study makes important contributions to this area. The findings of this research have shown that development/modernization has substantial influences on the age-crime distribution by increasing the youth share of offending for general property offenses. The differences in age-crime curves between Taiwan and the United States also show support for the variancy position and a recent argument by Thornton (2005). Thornton suggests that the development process is not uniform across nations due to culture diversity, specific geography and history, and different understanding on what the ideal development is. I will elaborate on this view below.

Culture Studies. Linked with Thornton's statement on development paradigm, this study presents a concern with the effects of culture on the social change process. This cultural perspective is also an important emergent orientation in sociology, criminology and criminal justice. Drawing on perspectives from traditional cultural studies, critical theory, postmodern theory, and interactionist sociology, and on media/textual analysis and ethnographic methodologies, this perspective focuses on issues of image, meaning,

and representation in the study of crime, crime control and other social phenomena. In contrast with the modernization theorists (i.e. Daniel Bell) who believe that economic development brings pervasive cultural changes globally, cultural scholars (i.e. Samuel Huntington) argue that cultural values are an autonomous and enduring force on society. Weber (1946) also suggests that cultural factors and material factors are interacted together during the process of modernization. That is, cultural factors may set the direction in which the material forces will be pointed.

As found in this project, different from the United States, the age-crime distributions for violent crime and other nonproperty offenses in Taiwan do not show a shift toward younger peaks and younger concentration. The regression analysis also shows that development does not have much impact on proportionate youth involvement in homicide, aggravated assault and total offenses. All these results indicate that the effects of industrialization/modernization on youth share of crime may not be as great in Taiwan as in the Western societies since traditional cultural mechanisms could mitigate these effects through specific adaptations. One reason for this is that the broad cultural heritage of society, such as Confucianism, leaves an imprint on values that endure despite development/modernization; once established, such a national culture will be transmitted by older generations, educational institutions and mass media (Inglehart and Baker 2000). These persistent traditional Chinese values thus reduce the effects of modernization. Similar findings in studies on Taiwan (Sun 1994; Thornton and Lin 1994) have been cited in Chapter 1. That is, youth in Taiwan are still highly supervised and protected by society and the traditional values are still encouraged at school and in families.

Consistent with Weber (1946), Thornton (2005) points out that one of the most powerful forces for development is the motivational ideas contained in developmental idealism. Instead of the culture residues of tradition, non-Western societies and newly industrialized countries tend to employ culture as strategic adaptation to the new forms of capitalist economic forces. Recognizing possible harmful effects of modernization, these nations try to form a more "ideal" society by integrating the beneficial sides of both modernity and traditionality (Wu 1994). In this way, they also hope to avoid the possibility of Westernization (One 1999; Geschiere 1988; Schech and Haggis 2002). Therefore, as suggested by some scholars on Taiwan (Chu 2000; Harrell 1994), Confucianism and traditional values may be endangered by development. However, the society and government may spend a lot of efforts to bring them back and integrate them with modernity (Mayers 1996). These efforts, thus, may help to reduce proportionate youth involvement in violent offenses and certain nonproperty offenses.

Comparative Approach. The integration of comparative and historical approach emphasized in this study is also an advantage compared to many previous studies. Comparative research (e.g. cross-national studies) can be used (1) to evaluate whether a theory derived from one society is also useful in other societies, that is, whether the theory is universal or limited in scope; (2) to generate a general theory to explain the differences from one society to another. In contrast, historical studies (same society at different times) put contemporary social phenomena into perspective, show how people reacted in the past, and suggest problems that may be encountered by nations now undergoing changes. In this study, by comparing the age-crime distributions in Taiwan and in the United States across time, the comparative approach is used to test whether the

age-crime curve is invariant or variant; by exploring the age-crime relationship in Taiwan from 1961 to 1991, the historical perspective is applied to address the important effects of socioeconomic changes on the age-crime curves. The analysis here can be considered an example for future comparative research.

Caveats and Avenues for Future Studies

The major caveat of this study is relying on official crime reports to measure the age-specific crime rates in Taiwan. Official arrest statistics usually are biased in important ways (see discussions in Biderman and Lynch 1991; Gove, Hughes, and Geerken 1985; Steffensmeier 1983). The arrest reports in Taiwan have three key problems that may affect the results of the analysis. First, due to the military draft of youth, the official crime statistics on those serving in the military (esp. for ages 19-24) may understate their crime volume. For example, the age-crime distribution for larceny in 1991 slightly increased in early 20s, which may be because youth in this age group returns to society after military service. Moreover, the age categories reported in Taiwan arrest statistics are somewhat inconsistent across time and also inconsistent with the population groups reported in the household registration data, which may confound the calculation of age-specific crime rates. Thus, I employed several procedures to account for these inconsistencies. The last problem is some ambiguity in robbery and larceny classification (see Chapter 2). For instance, larceny in earlier years was combined with burglary, while in late years it was combined with auto theft (the category for burglary officially disappears in the report).

To deal with these three problems, future research can improve this study in several ways. First, besides official data, replicate the study on the basis of other sources of data and then compare their results[22]. Furthermore, scholars may conduct some comparative research on military draft of youth and examine the effects of military service on youth crime involvement: whether they are less likely to commit

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[22] Taiwan government has started an annual youth survey since 1990s. But due to the limited number of years, we cannot analyze it using time series analysis.

crime due to strict supervision in military, or their offenses are simply handled by separate military justice system and thus not reflected in official crime reports.

Another limitation of this study is that no cultural variables are directly examined in the analysis. All discussions on cultural issues are based on prior theories and literature. Since there is little quantitative information available on Taiwan culture, qualitative studies may be an alternative choice to explore the relationship between development, culture, and youth criminal offending.

The next caveat is related with the findings showing that for some offenses, the age-crime distributions for some offenses shift in different directions in the earlier development period as compared to the late development period. This implies that certain curvilinear effects may exist in the relationship between development and age-crime distribution and future research can try to examine it. As the modernization thesis (e.g. Shelley 1981) suggests, at early stages of industrialization, traditional social structures are undermined in the growing cities (social disorganization, anomie and weak control) which, in turn, leads to increases in property crime. At the same time the newly arrived migrants from rural area bring with them the traditions of violence which brings increases in violent offenses. At a later period of development, property offenses continue to rise since there are more opportunities, while the violent crime subsides as rural migrants become adjusted to urban life.

Future research also needs to test the *variancy* perspective in terms of whether there is variation in age-crime distributions across gender and race groups. Although Steffensmeier and Streifel (1991) conclude that the age-crime curves of both genders are quite similar (except male rates are always higher than female rates) across all offenses

and time periods, they do find that females tend to have a younger distribution and lower peak age. This might be explained by differential association theories: girls are more likely to associate with older males. Earlier physical maturity of girls may also contribute to this patterning (Haynie 2003). As for race and ethnicity, some scholars indicate that blacks may have flatter age-crime curves than whites due to blacks‘ lower declines of crime during early adulthood (Wilson 1987; Sullivan 1989; Steffensmeier and Allan 1995). Steffensmeier explained (2002) this from an opportunity-commitment perspective: this slower decline from peak youth ages is because minority youth entering adulthood may be less able to mature out of their youth status on account of limited access to productive activities and other goals of conventional life which facilitate desistance from delinquent behavior, but instead may remain deeply embedded in deviant or delinquent subcultures that provide surrogates for such things as purpose, belonging, recognition, and prestige.

Conclusion

This dissertation project addresses an important issue in criminological and social science literature about the age-crime relationship. The *invariance* view (e.g. Hirschi and Gottfredson 1983) claims that the age-crime distribution is invariant and holds in all human societies at all times, while the *variancy* position (e.g. Steffensmeier, Allan, Harer, & Streifel 1989; Greenberg 1985) suggests that the age-crime relationship is not invariant but varying substantially across crime types, structural positions of groups and historical and cultural backgrounds. A central issue of this debate is whether development can

increase youth share of crime involvement and then lead to a younger age-crime distribution.

To examine the above questions, the age-crime curves in one Eastern society, Taiwan, were examined thoroughly across time periods and crime types, including comparison with the age-crime curves observed in the United States, a representative of Western nations. Moreover, advanced time-series techniques, such as nonlinear regression models and Dickey-Fuller tests, were applied to explore whether there is a statistically reliable pattern in age-crime distributions and whether development has influences on proportionate youth crime involvement. Both these aspects would make a contribution to filling up the previous research gap on the variancy-invariancy age-crime debate.

The results show considerable support for the variancy approach. That is, the age-crime curves in Taiwan vary across types of offenses and over time; the age-crime curves in Taiwan differ from the age-crime distributions in the United States even at similar level of development. Scholars holding the variancy position also believe that development contributes to the increased youth share of crime involvement. The present study shows evidence for this development explanation for general property offenses (except typical adult crimes such as fraud). Specifically, the age-crime curves for larceny and stolen property in Taiwan shift toward a younger distribution in the process of development. Such shifts are not found for violent crimes and other types of nonproperty offenses, which may be explained by the continuity of traditional culture (e.g. Confucionism and familism).

Besides contributing to the ongoing debate about the age-crime relationship, this project has broad implications for those interested in the sociology of age, sociology of youth, social change, culture, and comparative/historical research. Hopefully, with more available data sources and research methods, future research will extend the analysis here by examining the age-crime relationship in various societies and social groups.

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Appendix A

List of Taiwan Arrest Reports by Age and Offense Categories

Year	Age Categories	Types of Offenses
1961-1962	total, <14, 14-17, 18-20, 21-30, 31-40, 41-50, 51-60, 61-70, above 70, and unknown	total offenses, burglary and larceny, stolen property, robbery and forceful taking, homicide, aggravated assault, narcotic, fraud, forest law violations, and others
1963-1965	total, 1-11, 12-18, 19-20, 21-30, 31-40, 41-50, 51-60, 61-70, above 70, and unknown	total offenses, burglary and larceny, stolen property, robbery and forceful taking, homicide, aggravated assault, narcotic, fraud, forest law violations, and others
1966-1971	total, <12, 12-17, 18-20, 21-30, 31-40, 41-50, 51-60, 61-70, above 70, and unknown	total offenses, burglary and larceny, stolen property, robbery and forceful taking, murder, negligent manslaughter, aggravated assault, narcotic, fraud, forest law violations, and others
1972	total, <14, 14-17, 18-20, 21-30, 31-40, 41-50, 51-60, 61-70, above 70, and unknown	total offenses, burglary and larceny, stolen property, robbery and forceful taking, murder, negligent manslaughter, aggravated assault, narcotic, fraud, forest law violations, and others
1973	total, <14, 14-17, 18-20, 21-30, 31-40, 41-50, 51-60, 61-70, above 70, and unknown	burglary and larceny, stolen property, robbery and forceful taking, murder, negligent manslaughter, aggravated assault, narcotic, fraud, counterfeiting, forcible rape, against morals, embezzlement, and suicide
1974-1975	total, 1-11, 12-17, 18-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70+, and unknown	total, burglary and larceny, homicide, robbery and forceful taking, kidnapping, intimidation, aggravated assault, narcotic, stolen property, fraud, counterfeiting, embezzlement, malfeasance in office, smuggling, against morals, and others
1976-1978	total, <10, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30-39, 40-49, 50-59, 60-69, 70+, and unknown	total, burglary and larceny, homicide, robbery and forceful taking, kidnapping, intimidation, aggravated assault, narcotic, stolen property, fraud, counterfeiting, embezzlement, malfeasance in office, smuggling, against morals, and others
1979-1991	total, <10, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30-39, 40-49, 50-59, 60-69, 70+, and unknown	total, larceny and motor vehicle theft, homicide, robbery, forceful taking, kidnapping, intimidation, aggravated assault, weapons, stolen property, fraud, against morals, narcotics, gambling, negligence of driver, offenses against family, interference with public functions, offenses against public safety, and others

Appendix B

Percentage Age Involvement of Arrests in Taiwan, 1961, 1976 and 1991

Year*	Offenses	Under 14 (10-13)	14-17	18-20	21-30	31-40	41-50	51-60	61-70	above 70 (71-79)
1991	total	5.38	21.06	19.87	18.80	15.30	9.80	5.63	2.96	1.20
	violence	2.59	15.81	17.01	18.02	18.73	13.13	7.87	4.64	2.21
	property	17.17	34.34	14.50	11.89	9.88	6.27	3.38	1.93	0.64
	homicide	0.79	19.15	20.87	18.12	17.60	11.31	5.81	3.54	2.81
	aggravated assault	0.98	8.59	8.97	16.31	23.00	18.73	12.73	7.51	3.18
	robbery	6.37	24.58	26.67	20.60	12.92	5.77	1.83	0.99	0.26
	larceny	17.80	34.76	14.63	11.84	9.47	5.89	3.16	1.84	0.61
	stolen property	13.13	35.47	13.17	11.17	11.91	8.01	4.67	1.99	0.47
	fraud	0.41	5.95	13.13	17.99	23.51	19.34	10.30	6.36	3.02
1976	total	2.79	15.47	15.96	16.10	18.41	13.73	9.79	5.72	2.02
	violence	0.47	18.81	23.82	17.77	15.06	10.98	7.88	3.74	1.46
	property	7.12	25.30	18.98	15.41	13.52	9.64	6.19	3.03	0.82
	homicide	0.26	25.61	32.60	18.47	9.74	5.18	4.43	1.94	1.75
	aggravated assault	0.41	14.22	18.62	17.27	18.44	14.54	10.08	4.90	1.52
	robbery	1.70	31.83	34.76	19.30	6.60	2.72	2.37	0.71	0.00
	larceny	8.87	30.06	20.77	14.83	10.50	7.46	5.07	1.88	0.58
	stolen property	1.24	12.45	17.83	17.97	20.36	13.26	8.48	6.85	1.56
	fraud	0.07	2.52	6.40	17.09	29.47	22.55	12.30	7.72	1.89
1961	total	2.21	11.98	23.13	17.87	20.02	13.68	7.09	3.20	0.84
	violence	0.29	7.00	31.17	20.25	18.15	13.19	6.43	2.67	0.86
	property	3.29	16.57	23.76	16.59	19.13	11.95	5.72	2.34	0.65
	homicide	0.27	6.96	36.71	20.59	16.71	11.47	5.13	1.39	0.77
	aggravated assault	0.15	5.56	27.54	20.55	19.61	14.73	7.58	3.30	1.00
	robbery	1.49	18.61	42.98	16.84	10.95	6.19	1.37	1.58	0.00
	larceny	3.98	19.58	26.11	16.05	17.25	10.00	4.55	1.85	0.62
	stolen property	0.09	3.03	14.28	18.32	25.18	21.28	11.63	4.87	1.32
	fraud	0.06	2.19	11.36	19.88	30.60	20.72	10.63	4.34	0.23

Appendix C

Percentage Age Involvement of Arrests in Taiwan (Breakdown by Individual Ages 10-29), 1976 and 1991

Year*	Offenses	10	11	12	13	14	15	16	17	18	19	20
1991	total	0.34	0.72	1.58	3.09	5.03	5.22	6.08	6.15	6.87	5.82	3.22
	violence	0.23	0.37	0.8	1.63	3.05	4.12	5.83	5.66	6.82	5.48	2.67
	property	1.21	2.51	5.17	9.18	12.46	9.28	7.74	6.26	5.27	3.95	2.26
	homicide	0.04	0.08	0.27	0.51	1.62	4.62	7.72	7.89	9.03	6.11	2.51
	aggravated assault	0.04	0.2	0.24	0.88	2.2	3.21	3.53	3.03	3.87	3.76	1.78
	robbery	0.55	0.72	1.72	3.12	4.85	4.77	7.1	7.1	8.6	6.94	3.73
	larceny	1.28	2.66	5.32	9.32	12.43	9.31	7.84	6.32	5.27	3.96	2.26
	stolen property	0.4	0.98	4.11	8.98	14.81	10.48	7.41	5.74	5.25	3.85	1.81
	fraud	0	0	0.14	0.42	1.32	0.55	2.36	4.15	5.1	3.82	4.46
1976	total	0.3	0.52	0.98	1.62	2.91	4	4.82	7.36	4.93	5.94	3.89
	violence	0.01	0.07	0.18	0.28	1.29	3.27	5.94	11	7.17	8.34	4.84
	property	0.69	1.2	2.29	3.64	6.09	6.99	6.55	8.38	5.26	6.32	4.21
	homicide	0	0	0.06	0.21	0.99	3.37	8.49	13.87	8.91	10.73	5.79
	aggravated assault	0.02	0.06	0.18	0.23	1.1	2.85	4.25	9.14	5.81	7.05	4.12
	robbery	0	0.3	0.49	0.86	3.49	5.58	8.5	13.62	10.22	8.81	6.39
	larceny	0.82	1.45	2.74	4.36	7.18	8.16	7.44	9.22	5.65	6.66	4.3
	stolen property	0.19	0.15	0.45	0.7	1.97	2.93	3.49	6.68	4.87	6.64	4.67
	fraud	0	0	0	0.1	0.19	0.2	1.28	1.93	1.68	2.46	2.67

*All the years are taking a two-year average. For example, the 1991 PAI in fact is an average of 1991 and 1992.

Year*	Offenses	21	22	23	24	25	26	27	28	29
1991	total	3.32	4.78	5.54	6.05	5.49	5.78	5.37	5.2	5.1
	violence	3.1	4.58	5.23	6.21	5.72	6.67	5.88	6.15	6.21
	property	2.31	2.97	3.41	3.74	3.24	3.49	3.42	3.12	3.23
	homicide	3.23	4.49	5.22	6.59	5.78	6.21	5.37	5.85	5.36
	aggravated assault	2.46	4.21	5.12	6.69	6.05	7.32	7.2	7.34	8.18
	robbery	3.69	5.04	5.34	5.45	5.33	6.25	4.78	5.08	4.64
	larceny	2.36	3.02	3.38	3.67	3.16	3.41	3.33	3.06	3.16
	stolen property	1.58	1.99	3.34	3.86	3.67	3.8	3.82	3.47	3.22
	fraud	2.55	4.47	6.1	8.2	6.92	6.86	7.63	5.54	8.19
1976	total	2.67	3.48	4.68	5.31	5.97	6.49	6.32	6.25	6.28
	violence	2.58	3.49	5.3	5.78	6.53	6.24	5.65	5.75	5.18
	property	2.89	3.36	4.09	4.26	4.98	5.16	4.97	4.74	4.73
	homicide	2.83	4.29	5.46	5.42	5.98	5.25	4.44	3.91	4.02
	aggravated assault	2.02	2.94	5.31	6	7.03	6.95	6.63	7.12	6.23
	robbery	5.36	4.42	4.8	5.59	5.17	4.88	3.33	2.95	2.22
	larceny	3.06	3.44	4.09	4	4.33	4.47	4.22	3.85	3.79
	stolen property	1.77	3.01	3.91	5.64	8.2	7.55	7.5	7.05	7.39
	fraud	2.62	3.03	4.33	5.23	7.5	9.19	9.45	10.87	11.06

*All the years are taking a two-year average. For example, the 1991 PAI in fact is an average of 1991 and 1992.

Appendix D

Values of Juvenile Crime Rates, Adult Crime Rates, PAI, and Log Ratio

Juvenile Crime Rates

Year	Total Offenses	Violent Index	Property Index	Homicide	Aggravated Assault	Robbery	Larceny	Stolen Property	Fraud
61	236.95	18.32	197.47	4.72	10.38	3.22	192.36	2.83	2.28
62	274.41	25.34	224.59	6.43	12.12	6.79	220.14	2.78	1.68
63	352.37	42.59	277.42	15.42	19.49	7.68	269.28	5.12	3.02
64	325.14	30.05	272.65	8.03	18.36	3.66	266.98	4.07	1.59
65	390.05	44.32	310.59	16.05	22.32	5.95	300.60	6.22	3.77
66	397.16	49.77	312.93	17.18	25.87	6.73	303.05	6.98	2.90
67	320.24	41.56	243.71	12.10	22.87	6.59	238.30	3.74	1.67
68	383.92	63.43	274.80	19.81	34.09	9.53	266.77	5.63	2.39
69	414.03	73.65	290.57	23.61	39.22	10.82	279.56	9.04	1.96
70	377.00	51.40	277.07	16.08	26.63	8.70	266.12	8.47	2.48
71	321.39	51.39	224.49	19.24	22.26	9.89	215.05	7.42	2.02
72	336.57	48.84	240.14	18.01	21.63	9.21	226.46	11.17	2.50
73	401.99	52.29	286.26	19.66	20.60	12.03	273.28	10.73	2.24

74	344.32	42.41	257.50	13.32	17.61	11.49	241.84	13.49	2.17
75	323.54	51.73	209.08	16.12	24.40	11.21	196.39	9.91	2.77
76	284.24	48.82	169.10	17.12	24.60	7.10	159.08	8.38	1.64
77	307.86	47.94	192.44	19.10	22.36	6.48	181.72	9.28	1.44
78	307.73	49.38	189.05	19.10	25.04	5.24	179.19	8.46	1.40
79	518.10	76.87	329.81	26.05	37.81	13.00	312.51	15.03	2.27
80	447.10	49.11	305.54	20.40	21.29	7.42	285.99	17.85	1.70
81	472.50	47.73	335.65	19.18	19.82	8.73	308.25	26.15	1.24
82	417.70	39.84	303.14	16.46	12.27	11.11	280.37	21.17	1.60
83	448.40	46.52	308.55	19.16	9.43	17.93	284.07	23.21	1.27
84	492.20	48.05	331.60	18.80	13.05	16.19	303.59	26.77	1.24
85	512.30	51.90	345.10	13.56	16.60	21.74	323.80	18.52	2.77
86	711.90	67.75	526.95	14.99	29.45	23.31	490.68	33.51	2.76
87	787.60	80.61	559.69	18.41	32.38	29.83	521.14	36.31	2.24
88	796.50	89.16	559.23	16.15	28.07	44.94	530.58	26.84	1.82
89	881.60	118.52	616.49	19.71	24.66	74.15	590.88	23.58	2.02
90	769.00	80.97	470.72	16.95	14.15	49.87	450.39	18.51	1.82
91	1110.30	51.26	547.83	11.46	12.47	27.33	514.09	32.08	1.66

Adult Crime Rates

Year	Total Offenses	Violent Index	Property Index	Homicide	Aggravated Assault	Robbery	Larceny	Stolen Property	Fraud
61	469.19	89.24	257.15	21.31	62.53	5.40	198.33	28.82	30.00
62	468.81	83.10	256.30	22.13	55.30	5.66	197.14	28.94	30.22
63	448.09	76.13	251.37	19.81	52.12	4.20	192.39	31.31	27.68
64	386.13	62.53	227.12	17.64	42.27	2.63	181.62	25.04	20.46
65	406.64	73.04	220.63	20.85	48.62	3.57	167.26	31.17	22.20
66	388.32	69.70	197.78	20.39	45.86	3.45	148.87	29.00	19.91
67	324.80	66.02	154.82	19.77	43.62	2.63	120.48	19.38	14.96
68	321.41	71.52	141.21	20.56	48.30	2.67	106.53	18.72	15.95
69	333.57	75.03	139.46	21.47	50.83	2.73	101.36	22.09	16.01
70	319.60	67.86	137.39	21.66	42.63	3.57	95.71	25.77	15.91
71	286.50	57.94	117.94	19.87	35.72	2.35	81.21	21.15	15.57
72	229.20	49.24	92.51	18.33	28.00	2.91	63.62	16.37	12.52
73	293.40	39.93	119.86	11.38	25.01	3.54	85.60	22.66	11.61
74	336.00	47.91	144.08	12.55	30.11	5.25	103.20	27.57	13.31
75	352.90	56.09	131.22	13.43	37.27	5.38	91.37	22.25	17.61
76	349.60	51.06	107.52	12.71	34.93	3.42	74.39	15.67	17.46
77	372.10	55.58	104.16	13.70	38.20	3.68	75.44	14.35	14.37

78	306.10	47.78	94.44	13.55	32.12	2.12	70.77	13.24	10.44
79	335.80	81.48	187.88	18.67	54.77	8.04	141.98	16.82	29.07
80	311.30	44.29	104.82	12.15	26.24	5.89	84.04	12.22	8.56
81	286.40	37.15	114.11	11.04	19.40	6.70	87.88	19.11	7.12
82	245.10	30.49	95.36	11.00	12.36	7.14	78.24	11.86	5.26
83	279.80	34.25	106.06	12.68	13.00	8.57	87.31	13.09	5.66
84	310.10	34.92	112.51	13.55	13.26	8.11	93.60	13.54	5.38
85	366.50	45.30	117.66	12.12	23.92	9.26	96.48	12.30	8.88
86	505.90	70.33	152.50	13.51	45.46	11.36	125.52	15.99	10.99
87	534.20	71.28	121.92	13.06	47.07	11.15	104.11	8.79	9.01
88	479.00	68.64	113.98	12.13	41.58	14.93	100.80	7.38	5.81
89	494.10	69.70	120.02	12.03	34.11	23.55	108.16	6.07	5.79
90	502.30	58.98	108.07	12.20	28.17	18.60	96.90	5.75	5.42
91	853.50	63.25	150.81	13.39	33.39	16.47	134.28	11.04	5.48

Youth Percentage (PAI)

Year	Total Offenses	Violent Index	Property Index	Homicide	Aggravated Assault	Robbery	Larceny	Stolen Property	Fraud
61	33.56	17.03	43.44	18.13	14.24	37.35	49.24	8.94	7.06
62	36.92	23.37	46.70	22.51	17.98	54.54	52.76	8.76	5.27
63	44.02	35.87	52.46	43.77	27.22	64.65	58.33	14.05	9.84
64	45.71	32.46	54.56	31.28	30.28	58.19	59.51	13.98	7.21
65	48.96	37.76	58.47	43.50	31.46	62.50	64.25	16.64	14.52
66	50.56	41.66	61.27	45.73	36.07	66.11	67.06	19.40	12.71
67	49.65	38.63	61.15	37.97	34.40	71.48	66.42	16.18	10.04
68	54.43	47.00	66.06	49.07	41.38	78.11	71.46	23.12	13.03
69	55.38	49.54	67.57	52.37	43.55	79.85	73.39	29.04	10.91
70	54.12	43.10	66.85	42.61	38.45	70.90	73.55	24.74	13.49
71	52.87	47.00	65.56	49.19	38.39	80.80	72.59	25.97	11.48
72	59.49	49.80	72.19	49.56	43.58	75.99	78.07	40.56	16.64
73	57.81	56.70	70.49	63.34	45.17	77.26	76.15	32.14	16.17
74	50.61	46.96	64.12	51.49	36.90	68.64	70.09	32.85	14.02
75	47.83	47.98	61.44	54.55	39.57	67.57	68.25	30.81	13.59
76	44.84	48.88	61.13	57.39	41.32	67.49	68.14	34.84	8.59
77	45.28	46.31	64.88	58.23	36.92	63.78	70.66	39.27	9.11

78	50.13	50.82	66.69	58.50	43.81	71.20	71.69	38.99	11.82
79	60.67	48.54	63.71	58.25	40.84	61.79	68.76	47.19	7.24
80	58.95	52.58	74.46	62.67	44.79	55.75	77.29	59.36	16.57
81	62.26	56.23	74.63	63.47	50.54	56.58	77.82	57.78	14.83
82	63.02	56.65	76.07	59.94	49.82	60.88	78.18	64.09	23.32
83	61.58	57.60	74.42	60.18	42.04	67.66	76.49	63.94	18.33
84	61.35	57.91	74.67	58.11	49.60	66.63	76.43	66.41	18.73
85	58.30	53.40	74.57	52.80	40.97	70.13	77.04	60.09	23.78
86	58.46	49.07	77.56	52.60	39.31	67.23	79.63	67.70	20.07
87	59.59	53.07	82.11	58.50	40.76	72.79	83.35	80.51	19.91
88	62.45	56.50	83.07	57.11	40.30	75.06	84.03	78.43	23.85
89	64.08	62.97	83.70	62.10	41.96	75.90	84.53	79.53	25.86
90	60.49	57.86	81.33	58.15	33.44	72.83	82.29	76.30	25.14
91	56.54	44.76	78.41	46.12	27.19	62.40	79.29	74.40	23.25

Youth-to-Adult Log Ratio

Year	Total Offenses	Violent Index	Property Index	Homicide	Aggravated Assault	Robbery	Larceny	Stolen Property	Fraud
61	-0.68	-1.58	-0.26	-1.51	-1.80	-0.52	-0.03	-2.32	-2.58
62	-0.54	-1.19	-0.13	-1.24	-1.52	0.18	0.11	-2.34	-2.89
63	-0.24	-0.58	0.10	-0.25	-0.98	0.60	0.34	-1.81	-2.22
64	-0.17	-0.73	0.18	-0.79	-0.83	0.33	0.39	-1.82	-2.55
65	-0.04	-0.50	0.34	-0.26	-0.78	0.51	0.59	-1.61	-1.77
66	0.02	-0.34	0.46	-0.17	-0.57	0.67	0.71	-1.42	-1.93
67	-0.01	-0.46	0.45	-0.49	-0.65	0.92	0.68	-1.65	-2.19
68	0.18	-0.12	0.67	-0.04	-0.35	1.27	0.92	-1.20	-1.90
69	0.22	-0.02	0.73	0.10	-0.26	1.38	1.01	-0.89	-2.10
70	0.17	-0.28	0.70	-0.30	-0.47	0.89	1.02	-1.11	-1.86
71	0.11	-0.12	0.64	-0.03	-0.47	1.44	0.97	-1.05	-2.04
72	0.38	-0.01	0.95	-0.02	-0.26	1.15	1.27	-0.38	-1.61
73	0.31	0.27	0.87	0.55	-0.19	1.22	1.16	-0.75	-1.65
74	0.02	-0.12	0.58	0.06	-0.54	0.78	0.85	-0.71	-1.81
75	-0.09	-0.08	0.47	0.18	-0.42	0.73	0.77	-0.81	-1.85
76	-0.21	-0.04	0.45	0.30	-0.35	0.73	0.76	-0.63	-2.37
77	-0.19	-0.15	0.61	0.33	-0.54	0.57	0.88	-0.44	-2.30

78	0.01	0.03	0.69	0.34	-0.25	0.90	0.93	-0.45	-2.01
79	0.43	-0.06	0.56	0.33	-0.37	0.48	0.79	-0.11	-2.55
80	0.36	0.10	1.07	0.52	-0.21	0.23	1.22	0.38	-1.62
81	0.50	0.25	1.08	0.55	0.02	0.26	1.25	0.31	-1.75
82	0.53	0.27	1.16	0.40	-0.01	0.44	1.28	0.58	-1.19
83	0.47	0.31	1.07	0.41	-0.32	0.74	1.18	0.57	-1.49
84	0.46	0.32	1.08	0.33	-0.02	0.69	1.18	0.68	-1.47
85	0.33	0.14	1.08	0.11	-0.37	0.85	1.21	0.41	-1.16
86	0.34	-0.04	1.24	0.10	-0.43	0.72	1.36	0.74	-1.38
87	0.39	0.12	1.52	0.34	-0.37	0.98	1.61	1.42	-1.39
88	0.51	0.26	1.59	0.29	-0.39	1.10	1.66	1.29	-1.16
89	0.58	0.53	1.64	0.49	-0.32	1.15	1.70	1.36	-1.05
90	-0.68	-1.58	-0.26	-1.51	-1.80	-0.52	-0.03	-2.32	-2.58
91	-0.54	-1.19	-0.13	-1.24	-1.52	0.18	0.11	-2.34	-2.89

Appendix E

Values of Independent and Control Variables in the Annual Time-Series Regression Analysis

year	GDP per capita	HDI	Growth rate	GINI	Unemployment	% youth	% Urban	Divorce Rate	Clearance
1961	153	0.461	-1.31			11.41	29.2	0.41	
1962	164	0.471	6.71			11.89	29.6	0.41	81.14
1963	180	0.481	8.89			12.82	29.7	0.39	63.69
1964	205	0.495	12.2	32.24	4.34	13.82	30.2	0.38	71.52
1965	220	0.505	6.82	32.34	3.29	14.51	30.4	0.39	75.15
1966	238	0.51	7.56	32.43	3.02	14.88	31	0.38	83.39
1967	268	0.522	11.19	30.66	2.29	15.29	33.6	0.37	84.77
1968	307	0.536	12.7	28.90	1.72	15.6	36.6	0.36	85.91
1969	343	0.552	10.5		1.88	15.28	37.3	0.36	86.25
1970	389	0.564	11.83		1.70	15.12	37.9	0.37	86.57
1971	443	0.573	12.19		1.66	14.83	38.6	0.36	84.42
1972	522	0.589	15.13	29.02	1.49	14.64	39.3	0.37	81.09
1973	696	0.608	25	33.60	1.26	14.91	41.4	0.38	86.55

1974	921	0.626	24.43	28.09	1.53	14.83	42.8	0.43	86.4
1975	970	0.633	5.05	31.20	2.40	14.75	43.9	0.47	86.75
1976	1147	0.658	15.43	29.60	1.78	14.75	44.4	0.5	88.88
1977	1309	0.668	12.38	28.00	1.72	14.42	44.8	0.55	87.11
1978	1581	0.683	17.2	28.43	1.67	14	45.4	0.63	84.65
1979	1919	0.697	17.61	27.70	1.28	13.86	46.8	0.72	84.57
1980	2348	0.711	18.27	27.96	1.23	13.24	47.2	0.76	83.74
1981	2683	0.722	12.49	28.23	1.36	12.88	48	0.83	84.3
1982	2654	0.724	-1.09	28.51	2.14	12.54	49.2	0.93	83.34
1983	2819	0.731	5.85	28.45	2.71	12.23	49.5	0.94	83.19
1984	3134	0.741	10.05	28.81	2.44	11.89	49.9	1.01	89.22
1985	3243	0.747	3.36	29.20	2.91	11.61	50.7	1.11	79.15
1986	3897	0.761	16.78	29.29	2.66	11.38	52.3	1.16	77.35
1987	5169	0.78	24.61	29.65	1.97	11.13	53.4	1.18	79.57
1988	6177	0.792	16.32	30.02	1.69	11.04	54.4	1.26	74.33
1989	7341	0.804	15.86	30.41	1.57	11.05	54.7	1.25	76.38
1990	7761	0.811	5.41	30.11	1.67	11.04	55.4	1.36	73.8
1991	8769	0.823	11.5	30.49	1.51	11.13	55.5	1.38	83.05

Appendix F

Correlations for Larceny in the Initial HDI Model (with Potential Collinearity Problem)

Variables	Y	X1	X2	X3	X4	X5	X6	X7	X8
(Y) Log Ratio of Youth-to-Adult Larceny Rates	1	.803**	.145	-.041	-.189	-.737**	.811**	-.853**	.824**
(X1) HDI		1	.004	-.165	-.060	-.583	.993**	-.940**	.949**
(X2) Growth Rate			1	.063	-.541**	.040	.023	.091	-.112
(X3) Gini				1	.194	-.121	-.173	.053	-.051
(X4) Unemployment					1	-.075	-.079	-.149	.106
(X5) Clearance Rate						1		.715**	-.705**
(X6) % Urban Population							1	-.923**	.934**
(X7) % Youth (Ages12-17)								1	-.988**
(X8) Divorce Rate									1

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