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Delinquency, Capital and Social Institutions

by

Ambrose Leung, B.S., M.A.

**A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfilment of the requirements for the degree of**

**Doctor of Philosophy
Department of Economics**

**Carleton University
Ottawa, Ontario
May 2001**

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acceptance of the thesis,

"Delinquency, Capital and Social Institutions"

submitted by

Ambrose Leung, B.S., M.A.

in partial fulfilment of the requirements
for the degree of Doctor of Philosophy

Chair, Department of Economics

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April 2001

Abstract

This thesis examines the problem of juvenile delinquency from an economic perspective. To do so a theory is constructed using a time allocation model to encompass a set of choices faced by adolescents. The model's predictions then become hypotheses for empirical testing using data from the Montréal Longitudinal Study. In addition to traditional economic variables, different social institutions such as school, family, church, workplace, and peers are included in the analysis to explain delinquency. Chapter 1 provides a general introduction to the thesis.

Chapters 2 motivates the analysis by reviewing the literature on the economics of crime and delinquency to identify research opportunities in the area. One problem with the literature is the lack of a consistent theoretical underpinning for the empirical evidence presented on delinquency. Chapter 3 develops a theoretical model to explain juvenile delinquency and decision choices on time uses of adolescents. From an economic perspective, the problem of delinquency can be considered partly as a time allocation problem and partly as the human/social capital accumulation process. The theory assumes the capital accumulation process to be generated through various social institutions and networks such as school, family, church, workplace, and peers.

Chapter 4 examines empirically the effects of the various factors on self-reported delinquent behaviour. Estimations are conducted using both cross-sectional and panel data. Chapter 5 examines empirically the relationship between the different factors and schooling decisions. The amount of time spent on delinquency, schooling, and market work is modeled as a joint decision-making process in this chapter. The results show that influence from various social institutions have significant relationships with the level of delinquency and the schooling decision.

Chapter 6 uses official delinquency records to examine the question of who gets convicted and to explore the use of statistical discrimination by police and the courts. It is suggested that it is possible for police and the courts to use certain criteria such as individual social characteristics in delinquency investigation and conviction in order to minimize search costs. Estimation results show that while most forms of self-reported delinquency have no significant relationship with the probability of getting convicted, individual social characteristics such as being a student, living with biological parents, attending church, and association with delinquent peers are found to have significant relationship with the probability of acquiring an official delinquent record. Chapter 7 concludes the dissertation by providing some policy implications based on the results obtained from the analysis.

Dedication

To all the children who are lost in the culture of youth crime and violence

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Table of Contents

	Page
Abstract	iii
Dedication	iv
Acknowledgements	v
Table of Contents	vi
List of Tables	viii
List of Figures	x
 Chapter 1: Introduction	 1
 Chapter 2: Literature Survey	 8
2.1 Economics of Crime and Punishment: A Review of the Theoretical Literature	9
2.2 Economics of Delinquency: A Review of the Empirical Literature	32
2.3 Further Research Opportunities and Concluding Remarks	46
 Chapter 3: A Theory of Delinquency	 49
3.1 Human and Social Capital	50
3.2 Theoretical Model	56
3.3 Conclusion	78
Appendix 3A	81
Appendix 3B	83
Appendix 3C	87
Appendix 3D	91
Appendix 3E	95
 Chapter 4: An Empirical Study of Delinquency	 97
4.1 The Montréal Study	98
4.2 Concluding Remarks	138
Appendix 4A	141
Appendix 4B	143
Appendix 4C	144
 Chapter 5: Schooling and Delinquency	 146
5.1 Empirical Analysis	147
5.2 Conclusion	162
Appendix 5A	164

Chapter 6: Official Juvenile Delinquent Record	166
6.1 Theory	170
6.2 The Montréal Study	173
6.3 Conclusion	202
Appendix 6A	205
Appendix 6B	208
Appendix 6C	210
 Chapter 7: Conclusion	 212
 References	 218

List of Tables

Table 2.1	Summary of Empirical Literature	45
Table 3.1	Relationship Between Wages and Time Uses	64
Table 3.2	Relationship Between Police Expenditure and Time Uses	66
Table 3.3	Relationship Between the Institutional Variables and Time Uses: Participation in All Activities	68
Table 3.4	Relationship Between the Institutional Variables and Time Uses: Non-participation in Delinquency	77
Table 4.1A	Definitions of Dependent Variables	104
Table 4.1B	Definitions of Explanatory Variables	105
Table 4.2	Summary Statistics of Variables	110
Table 4.3A	Relationship of Traditional Economic Variables to Delinquency: Coefficients of Variables	115
Table 4.3B	Relationship of Traditional Economic Variables to Delinquency: Marginal Effects of Variables	117
Table 4.4	Relationship of Different Forms of Institutions to Delinquency	118
Table 4.5	Relationship between Institutional Variables and Delinquency: Panel Data Analysis	128
Table 4.6	Wald Chi-Square Statistics for the Institutional Variables In the Model Without Individual-Specific Effects	130
Table 4.7	Effects of Various Factors on Violent Acts and Property Crimes: A Bivariate Probit Analysis	134
Table 4C	Relationship between each Explanatory Variable and Other Explanatory Variables Measured by Auxiliary R^2	144
Table 5.1	Definitions of the Dependent Variables	149
Table 5.2	Factors Affecting Time Spent in School	151
Table 5.3	Effects of Various Factors on Schooling, Delinquency, and Market Work: A Multivariate Probit Analysis	155
Table 5.4	Effects of Various Factors on Schooling and Delinquency: A Bivariate Probit Analysis	158
Table 5.5	Wald Chi-Square Statistics to Test the Differences between The Coefficients of the Univariate and Bivariate Probit Models	161
Table 5A	Relationship between Grade and School Attendance	164
Table 6.1	Definitions of Variables	174
Table 6.2	Summary Statistics of Variables	176
Table 6.3A	Coefficients and T-statistics of Factors Affecting Official Delinquent Records: Representation of Regional Characteristics by Regional Dummies	189
Table 6.3B	Marginal Effects of Factors Affecting Official Delinquent Records: Representation of Regional Characteristics by Regional Dummies	192

Table 6.4	Factors Affecting Official Delinquent Records: Representation of Regional Characteristics by Unemployment Rate and Police Expenditure	189
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List of Figures

Figure 3.1	Marginal Cost and Marginal Benefit of Delinquency	74
Figure 3.3	The Distribution of Ω for a Population of Individuals	75

Chapter 1

Introduction

Researchers and policy makers had long been searching for possible causes of delinquency. Is it the decision to give up school? Lack of parental guidance? Paucity of a spiritual dimension? Association with the wrong crowd? Or inborn criminality? "The new teen wave is bigger, richer, better educated and healthier than any other in history. But there's a dark side..." (Kantrowitz and Wingert, 1999) "The story of the slaughter at Columbine High School opened a sad national conversation about what turned two boys' souls into poison..." (Gibbs, 1999). Media coverage on teen violence is accentuated by the recent high school shootings such as the one in Littleton, Colorado. In response to the tragic events, the U.S. Senate has approved \$25 million in new money for behavioural and social science research on youth crime and violence.

Of course, these kinds of policy relevant questions always interest scholars from various disciplines, including sociologists, psychologists, and economists. Although these disciplines attempt to explain and tackle the problem of crime from different angles, the various methods are often complements to, instead of substitutes for, each other.

Chapter 2 provides a literature survey on the economics of crime to identify research opportunities in the area. Chapter 3 develops a theoretical model to explain juvenile delinquency and decision choices on time uses of adolescents. Chapter 4 presents some empirical results on delinquency participation using data from the Montreal

Longitudinal Study. Chapter 5 uses the same data set to explore the schooling decisions of adolescents. Chapter 6 examines the relationship between the acquisition of official delinquency records and police behaviour. Chapter 7 summarizes the findings from the dissertation and provides some policy implications.

This dissertation focuses on the problem of juvenile delinquency and uses data from the Montreal Longitudinal Study to examine the phenomenon. There exists a large body of empirical literature on the economics of delinquency, mostly concerned about the relationship between youth unemployment and juvenile delinquency. One major problem with the literature is the lack of a consistent theoretical underpinning for the empirical evidence presented, with a few exceptions such as Grogger (1998).

From an economic perspective, the problem of delinquency can be considered partly as a time allocation problem and partly as the human/social capital accumulation process. Human and social capital refer to the productive resources of an individual accumulated through investment and interpersonal activities (Becker, 1964 and 1996). The capital accumulation process is often generated through various social institutions and networks such as school, family, church, workplace, and peers.

The purpose of Chapter 3 is to construct a model that encompasses the broader set of activity choices faced by an adolescent in the time allocation problem. Furthermore, the model discusses not only market determinants of choice, but also social influence on the activity choices of youth. The dissertation therefore provides the necessary links between the time allocation problem and the capital accumulation process for the examination of

juvenile delinquency, links that are largely ignored by the economics of crime and delinquency literature.

In this dissertation, capital is assumed to promote productivity in either market work, crime, or schooling. Work-productive capital is assumed to increase the wages earned in market work and to increase the psychic costs of individual who gets caught from crime. Work-productive capital can be accumulated mainly through the workplace, although family and church can also possibly generate work-productive capital. Crime-productive capital is assumed to increase the wages earned from criminal work, to decrease the probability of police detection, and to decrease the returns from investment in schooling. Crime-productive capital is assumed to be accumulated mainly through delinquent peers. School-productive capital is assumed to increase additional future earnings as a result of investment in schooling and to decrease the returns (wages) from criminal work. School-productive capital is assumed to be accumulated mainly through school-related activities, although it is also possible to increase the level of school-productive capital through other social institutions such as family and church. These three types of capital can therefore be considered as market-specific informational capital that can be accumulated to augment an individual's productivity in different market sectors, that is, work, crime, and school.

The theoretical model assumes that an adolescent wishes to maximize expected utility subject to time and budget constraints. The expected utility depends on two possible states of the world, namely getting caught and not getting caught engaging in

delinquent activities. The adolescent is assumed to maximize utility by choosing time spent on different activities. Theoretical implications from the comparative static exercises show that the accumulation of work-productive and school-productive capital are negatively related to the time spent on delinquency, and the accumulation of crime-productive capital is positively related to the time spent on delinquency. These theoretical implications are then used as testable hypotheses for the empirical part of the dissertation. Theoretical implications of participation versus non-participation in delinquency are also examined.

Chapter 4 examines empirically the effects of the various capital variables on delinquent behaviour. This dissertation uses data from a research project conducted by the University of Montreal. The Montreal Longitudinal Study is a rich data-base that contains demographic and behavioural information of 1069 boys who were all 6 years old in 1984 and had similar backgrounds. Data from the Montreal Longitudinal Study had been used to test different phenomena throughout the years, mostly within the context of psychology. The data-base had not yet been explored by economists and provides excellent opportunities to examine delinquency issues for the purpose of this dissertation.

The data set provides two measures of delinquency, official delinquency record and self-reported delinquency. Chapter 4 focuses on self-reported delinquency as a measure of delinquency participation. The explanatory variables are mostly factors that represent the various capital-generating institutions, including school, family, church, peers, and the workplace. Other explanatory variables are also included such as the

amount of pocket money, unemployment rate, the level of police expenditure, and regional differences. The first set of regressions estimated will use cross-section data from 1995 as the benchmark case.

The Montreal Longitudinal Study provides an informative data set which follows the same individuals for a number of years. This provides excellent opportunities to explore the effects of the various capital variables on delinquency over time. The study will therefore be extended to a panel data analysis. Stable individual traits such as inborn criminality are considered by some researchers to be the most important causes of delinquency (Gottfredson and Hirschi, 1990). Such individual characteristics are unobservable and relatively stable over time. This argument implies that social influences are of secondary importance. For example, most psychological arguments view the problem of crime as originated from the mind and thoughts inside an individual, and not from the external environments.

Individual fixed effects are incorporated in the longitudinal analysis for two reasons. First, the estimates for the capital variables can be biased when individual fixed effects are ignored in longitudinal analysis. Second, the individual fixed effects partly capture individual traits such as criminal propensity. The incorporation of the individual fixed effects therefore provides an opportunity to examine the psychological argument and to correct for biased estimates at the same time.

Another issue that has recently captured media attention is youth violence. The Montreal Longitudinal Study provides a data-base that can segregate petty property crime

from violent behaviour. The various self-reported items are therefore separated into two groups according to this distinction and are estimated using a two-equation system. The goal of this exercise is to examine the possible different effects of the various capital-generating institutions on the two types of offences.

While the economic literature treats school time primarily as a factor influencing future earnings as in the human capital theory, the economics of crime literature has shown schooling to be an important factor in moderating delinquency behaviour (Phillips, and Votey, 1987a; Viscusi, 1986.). Although the two lines of arguments are related, few researchers had made the connections between the two. As mentioned earlier, schooling is an important part of the time allocation decisions of every adolescent. Chapter 5 attempts to examine the effects of various capital variables and delinquency on the schooling decision. The joint decision between schooling and delinquency participation is also discussed in this chapter.

Chapter 6 examines the question of who gets convicted. The Montreal Longitudinal Study also provides information on official delinquency records, although only cumulative records from the age of 10 to 17 are provided for the purpose of this dissertation. While most adolescents admit the commission of delinquency at some point of time, only a handful of them ever acquired an official delinquent record. In order to minimize search cost, it is possible for police and the court to use certain criteria such as individual social characteristics in delinquency investigation and conviction. Chapter 6 explores the role of statistical discrimination by police and the court.

Chapter 7 concludes the dissertation by providing some policy implications based on the results obtained from the analysis. Throughout the analysis, it is found that the presence of a delinquent best friend and criminal adult associate(s) appear to be particularly influential in affecting an individual's level of delinquency. From a theoretical perspective, adolescents who have close contacts with other delinquents or criminals are more ready to accumulate crime-productive capital. School and family, on the other hand, appear to be social institutions that can control the level of delinquency. This dissertation therefore provides evidence that various social institutions can affect an individual's capital accumulation process and time allocation decisions among different activities including delinquency.

Chapter 2

Literature Survey

Researchers and policy makers have long been searching for possible causes of crime and delinquency. This kind of policy-relevant question always interests scholars from various disciplines, including sociologists, psychologists, and economists. Since crime is best described as a type of social problem, sociology is the field which has the longest tradition in the development of the theory of crime. The different schools of sociological thoughts place the emphasis on the effects of external environments on individual deviant and criminal behaviour. Psychologists also attempt to provide an explanation and solution to crime and view the problem of crime as originated from the mind and thoughts inside an individual.

Policy prescriptions offered by sociologists and psychologists tend to tackle the problem by identifying the various external (in the case of sociologists) and internal (in the case of psychologists) causes that motivate a person to commit crime. Economists, on the other hand, tend to derive the solution to the problem by weighting benefits with costs and postulate individuals as rational decision-makers. The theoretical literature on the economics of crime comprises two main strands. The first examines individual choice decision regarding participation in various activities such as crime and crime prevention; the second addresses social forces to tackle crime.

2.1 Economics of Crime and Punishment: A Review of the Theoretical Literature

Individual Choice Behaviour

A handful of theoretical models are devoted to analyzing factors affecting individual career choice. Early formulations used individual risk attitude as an argument for criminal career choice. The rest of the literature attempted to explain individual job choice decision using cost-benefit analysis.

(1) Cost-benefit analysis

When deciding between a legal and an illegal career, an individual weighs the costs against benefits for each career option. As a general rule, Stigler suggested the application of the “marginal benefits = marginal costs” condition for the crime choice decision. Stigler (1970) argued that as the level of punishment increases, the marginal deterrence from heavy sanctions could be very small. When individuals decide whether to commit crime, they will weight the expected gains from crime with the expected penalties. These individuals will continue to commit crime until the expected penalties outweigh their expected gains from crime, that is, expected marginal penalty must equal to expected marginal gain when an optimal decision is reached for any rational individual. As marginal net gain approaches zero for serious offenses, the costly heavy punishment can be a waste of money. Stigler's answer to the question applies the “marginal benefits = marginal costs” rule. Following Stigler's argument, different kinds of costs have been shown to affect an individual's career decision.

Balkin and McDonald (1980) suggested time costs of searching for victims as an

important costs of criminal activities. The authors provided an analysis to model explicitly the behaviour of crime victims and considered their interaction with crime offenders. In equilibrium, criminal acts are determined by the supply of offenders' time searching for victims and the demand of victims' exposure time to provide the opportunities for offences. The main contribution of this paper was to derive the direct avoidance response behaviour of victims. The basic framework was an application of "labour-choice" model in the labour economic literature with choice under uncertainty. Potential victims decide the amount of exposure time and face the risk of being victimized. Offenders decide the amount of time allocated to criminal activities and face the risk of being caught by police.

To simplify the analysis, the authors assumed that all individuals, victims and offenders alike, are risk-neutral. Distinction was also made between "real crime" and "nominal crime." While larger population on the street can increase the amount of "nominal crime" through higher victim exposure, a larger population can increase the probability of apprehension and punishment and thus decreasing "real crime" rate. Through the supply and demand analysis of offences, Balkin and McDonald obtained basically similar results to those of previous literature, except for the effects on nominal crime rate. For example, it was shown that increasing penalty can have two effects: (1) a lower real crime rate, and (2) a higher exposure level, hence leading to an ambiguous effect on nominal crime rate. The authors thus emphasized the importance of victim exposure time in explaining crime.

Furlong (1987) argued that costs from crime involvement can include income

forgone from the next best career alternative. The author devised a general equilibrium model to analyze the interactive behaviour between criminals, victims of crime and law enforcement agency. He assumed that each individual in the population is either a criminal, a legal citizen working in the private sector, or a law enforcement officer. A crime happens when a criminal interacts with a legal citizen while a crime is prevented when a law enforcement officer observes the happening of a crime. In Furlong's original analysis, taxes are paid by only legal citizens to finance the law enforcement agency. If the individuals are risk-neutral, then the expected income of each group will be equal to each other at equilibrium. Furlong pointed out that law enforcement officers and criminals only serve to redistribute and never contribute to the production of real output. Only legal citizens in the private sector produce real output. Hence, the full optimum is the point where all individuals choose to become legal citizens and level of output will be at a maximum. At the full optimum, however, there is no threat of arrest so that individuals will be attracted to become criminals until expected incomes are equalized across the three occupations. Furlong, by using the relationships between the different groups of individuals, derived a technology of crime commission and prevention. The conclusion reached is that complete deterrence is optimal.

Lott (1987a) viewed the wealth of an individual as the opportunity cost to the individual of being incarcerated. Lott argued that wealthy individuals are usually more capable than less wealthy individuals in terms of earning power or ability, implying that opportunity costs, in terms of foregone wages for instance, of being sanctioned are higher

for the wealthier individuals. Purchase of legal services can then be viewed as the monetary value that a person is willing to pay to be “off the hook.” Assuming that better legal services can be purchased at a higher price, the court does not have to look at the actual amount that an individual pays for legal services, but such payments are supposed to be reflected by the strength (weakness) of the evidence presented in and considered by the court.

Malik (1990) suggested the possibility of avoidance activities undertaken by criminals. Avoidance costs from getting caught by police are therefore another type of costs considered by criminals. While the law enforcement agency invests resources into crime fighting, criminals may spend time and effort to avoid being caught. If increasing the level of sanctions leads to more avoidance activities by criminals and assuming that such activities are costly to society, then maximal punishment is not likely to be the optimal policy to implement. Malik's contribution to the literature is an interesting one because he argued from the viewpoint of the criminals by stating explicitly the kind of costs they face.

Increasing costs of choosing a legitimate career, such as increases in the marginal income and sales tax rate, serves to increase the benefits from choosing an illegal career. Koskela and Virén (1994) formulated a criminal choice model using wages and payoffs to criminal work. The different wage levels faced by different individuals determine whether a certain individual will choose a legal or criminal career. In their analysis, there exists a critical wage level at which an individual is indifferent between legal and criminal work.

Below that rate the individual will turn to crime. Koskela and Virèn (1997), in a later attempt, applied the quasi-linear, additively separable utility function between consumption and leisure. The specific utility function is used to examine an individual's decision choice between one non-criminal and two criminal activities. The authors reached the conclusion that the higher the probability of getting caught and the higher the penalty on one type of crime will induce criminal's crime switching to the other type of crime. Policing aims to increase the probability of detection and is therefore less efficient in the presence of crime substitutes than without it.

Marginal income tax rate and the sales tax rate of goods were shown to be positively related to involvement in criminal activities. Koskela and Virèn also showed that criminal activity is a decreasing function of the apprehension rate and the severity of punishment. The authors derived their results in terms of an aggregate criminal activity function. Their application to evidence on auto thefts and robberies in Finland will be discussed later.

Grogger (1998) devised a time allocation model to examine the youth criminal behaviour. In Grogger's model, individuals choose between market work and crime to sustain the desired level of consumption. The author assumed that, while the market wage is given and is the same for all individuals, returns to criminal activities can be different for different individuals. The author further assumed consumers are amoral so that an increase in the amount of time spent on crime reduced utility just as much as the increase in the amount of time spent on market work. Returns to the first hour of crime are

assumed to be greater than an individual's reservation wage. The given market wage must be greater than the reservation wage for an individual to do market work. Similarly, returns to crime must be greater than the reservation wage for an individual to participate in crime. At the equilibrium, therefore, marginal returns to crime must be equal to the market wage. Grogger thus provided a simple model without taken into account uncertainty and morality. The author justified the exercise by referring to the fact that the model was specifically designed to support his empirical studies, which will be discussed later in this chapter. To my knowledge, Grogger's model was the first to formalize the concept of criminal capital and the criminal behaviour of youth. Despite of the thoughtful intent, Grogger did not explicitly discuss the factors that can influence the level of criminal productivity. Other issues such as the effects of different social institutions on delinquency are yet to be explored.

In short, all arguments using cost-benefit analysis are based on the rule that the higher the costs of engaging in illegal work, the less likely an individual will choose to become a criminal.

(2) Individual attitudes towards risks and preferences

Models formulated to investigate individual decision on participation in illegitimate activities treat such activities as part of occupational choices between legal and illegal work (Ehrlich, 1973; Block and Heineke, 1975). Attitude towards risks was shown to have an effect on influencing an individual's participation in illegitimate activities.

While previous work focused on only cost of punishment, Ehrlich (1973)

considered both the costs and gains from illegitimate work simultaneously. By participating in illegal activities, an individual weighs the gains from increases in wealth and/or increases in psychic benefits against the risks of getting a penalty and other related costs. Participation in illegitimate activities was treated as part of occupational choice between legal and illegal work. Participation in legal work leads to some returns with certainty. Individuals select their optimal allocation of time and resources under uncertainty, depending on the respective opportunities presented to the individuals in the legal and illegal job markets.

Ehrlich further explained that convicted offenders face fewer opportunities in the legitimate job market due to acquisition of criminal records, for instance. Recidivism, therefore, may not be an indication of irrational behaviour, but the result of a change to a smaller opportunity set. Individuals were assumed to have the flexibility to choose any combinations between legitimate and illegitimate work at any point during their lifetime. This was referred to as the "optimal activity mix."

Ehrlich also pointed out that individual's decision on the amount of time spent in illegitimate work depends on the attitude towards risk. In particular, risk-lovers spend more time on illegitimate work than risk-neutral individuals, who in turn spend more time on illegal work than risk-avoiders. Hard core offenders are less deterred by increase in law enforcement effort because they are specialized in illegitimate work and have low involvement in the legal job market regardless of the level of law enforcement activities.

Block and Heineke (1975) devised a criminal choice model which features

multiattribute decision-making. According to Block and Heineke, earlier criminal choice models expressed all costs and benefits from illegitimate activities in terms of wealth alone. By assuming a more general preference restriction on utility and an active role of psychic costs, an individual's choice between legal and illegal work becomes more ambiguous than was suggested by earlier literature. For instance, an individual who is risk-averse and has a preference for honesty will participate in illegitimate activities only if the returns to illegal activity are greater than its expected costs and such returns outweigh the psychic costs. Hence, increasing the certainty of arrests and increasing penalties will deter offenders with such particular characteristics. It was also shown that knowledge of an individual's attitude towards risks did not provide sufficient information to deduce the inferiority of illegitimate activities. The amount of time spent on illegitimate activities was modeled to be jointly determined by the returns to illegitimate activities, the individual's attitudes towards risks, and his/her attitude towards honesty. If the population is comprised of identical individuals who are risk-averse and honest, then the level of illegal work can reach a minimum level by introducing very severe penalty. In essence, Block and Heineke questioned the validity of models using wealth as a single attribute.

The basic assumption in the economics of crime models was that individuals are rational and weigh costs against benefits of criminal participation when making decisions. From the literature on individual choice of criminal behaviour, we learnt that criminal participation was modeled as part of an individual's time allocation decision on leisure, market work, and crime. Many of the theoretical models also assumed specific forms of

utility functions such as quasi-linear and/or additively separable. These are useful constructs to provide manageable model so that important implications can be derived from the model. The literature, however, ignored various social forces that can affect criminal participation decisions such as peer influence, family background, and schooling decision. This dissertation will attempt to incorporate these important elements in the determination of delinquency choice.

Social Forces Against Crime

The other stream of the literature focuses on examining social forces against crime. This stream of literature has been emphasizing the derivation of the optimal level of crime prevention activities and punishment. It is also generally assumed that the existence of police and judicial system are given. The discussion of crime prevention policy was motivated by Becker.

The objective of Becker's (1968) paper is not only to discuss criminal choice behaviour, but also to derive optimal crime control policies. Becker developed a social loss function which consists of the net direct damage of the offence, the social cost of obtaining a certain form of punishment, and the social cost of punishment to the society. Harm and damages from crime are assumed to be positively related to the level of criminal activities and cause diseconomies. Marginal gains are decreasing and marginal damages are increasing from additional offences by criminals. The cost of apprehension and conviction was modeled as increasing functions of the size of police force, activities and

resources spent to avoid crime, summarized as crime fighting activities. These crime-fighting activities positively depend on probability of conviction, amount of criminal offences, arrests and other determinants. Becker also pointed out that almost all punishments, except fines, hurt the offenders as well as other members of society. Social costs of fines are about zero because optimal fines paid by offenders literally compensate the loss experienced by crime victims.

Becker then introduced the supply function of offence to carry out the process of minimizing total social loss with respect to the probability and severity of punishment. He assumed that individuals are rational and maximize their utility. Hence individuals make decisions by weighting the benefits to the costs of committing crime. Becker assumed that number of offences committed by a person decreases as the probability of conviction and the level of punishment become greater. He further argued that offenders are more deterred by higher probability of conviction than more severe punishment. By appealing to the expected utility theory, it is implied that offenders are "risk-lovers."

Becker next derived the optimality conditions of the market for offences. He showed that the marginal costs of changing the offences through a change in the probability of conviction must be less than that from the level of punishment. From the optimality conditions derived by Becker, the same relationship holds true for marginal revenue only if the elasticity of offences with respect to probability of conviction is greater than the elasticity of offences with respect to punishment. Becker concluded that social loss would be minimized by lowering the probability of conviction per offence to close to

zero and increasing the punishment per offence to a "sufficiently high" level. The conclusion reached has triggered other economists to give some thoughts about the problem of crime.

Shifts in the behavioural relations were also developed by Becker to obtain further implications. Becker's theoretical framework was consistent with actual observations that more serious offences have higher probability of conviction and more severe punishment such as longer prison terms. Other factors affecting the position of the behavioural functions include police salaries, police technology, and court reforms. The concept of discrimination can also be applied to explain different kinds of punishment received by different groups when committing the same offence. Murders, for example, are usually impulsive acts and are likely to be unresponsive to the severity of punishment (Hellman and Alper, 2000).

Becker also discussed advantages of fines over other forms of punishments. The most obvious advantage is that fines can be viewed as "transfer payments" where no additional resources are used up. Institutionalization, on the other hand, incurs additional costs to society. Besides, fines are a compensation to victims while other forms of punishment cost the victims additional resources in terms of tax payments, for example. Moreover, determination of optimal level of institutionalization requires knowledge of the elasticity of response of offences to change in punishment while such knowledge is not necessary for optimal fine determination. Of course, there are cases when victims can never be fully compensated by fines, for example, a murder. Becker suggested that

imprisonment and other forms of punishment will be beneficial to deter crime such as murder from happening in the future. Otherwise, fines should be used whenever possible

Formal crime control means the role of police and judicial system in crime fighting. While police are responsible for law enforcement, the judicial system decides on the methods of punishment and sentencing. The literature on public policy against crime has naturally divided itself into examining policing efforts and sentencing decisions.

(1) Law enforcement and policing efforts

Shavell (1991) distinguished between general and specific law enforcement efforts. With general enforcement effort, the enforcer is responsible for detecting different types of crimes and apprehending individuals committing any range of harmful acts. On the other hand, enforcers of specific enforcement effort focus on a single type of harmful act. Shavell showed in his model that general enforcement effort is sufficient to induce perfect deterrence for crimes with low harm level, and specific enforcement effort will not be necessary in this case. Specific enforcement effort shall be applied only after sanction has been maximized, but harm level keeps increasing in the case of serious crimes. Hence, optimal sanctions should be low for acts of small harmfulness or low gains, increase with the degree of harmfulness and gains, and reach the maximum only for the most harmful acts.

Using a similar approach as Shavell's (1991), Mookherjee and P'ng (1992) distinguished between monitoring and investigation in the enforcement of law. Monitoring

refers to the case when the law enforcement agency commits resources and observes activities of potential criminals directly. Investigation is the case when the law enforcement agency relies on external sources, that is, "whistle blowers," for information on criminal activities. Due to the nature of the two different kinds of enforcement activities, investigation is more cost effective than monitoring. Hence if the costs of investigation is low and offenses are reported at all levels, then investigation alone will suffice. However, the fact that victims very often do not report offenses they encountered implies that reliance on investigation is very likely to create social turmoil. Monitoring then becomes the prime method of law enforcement. The authors showed that small offenses can be deterred by monitoring alone. Furthermore, monitoring can provide the required marginal deterrence with a strictly increasing fine and investigation is not necessary. It was also proved that through monitoring, maximal fines are supposed to reserve for the most serious offenses. This implies that maximal punishment will not be optimal for low gain crime.

Freeman, Grogger, and Sonstelie (1996) investigated into the spatial concentration of crime. The authors showed that two neighbourhoods identical in preferences, abilities and environment, and wealth can either be crime-free or crime-ridden at equilibrium. This result relies on the key assumption that probability of a criminal getting caught is a decreasing function of the number of other practicing criminals in the same jurisdiction. As the number of criminals increases in an area, the chances of an average criminal getting caught will decrease as fixed police resources are diverted. In a dynamic setting, the

authors showed that the more crime criminals have chosen to commit in the current period tends to increase the returns to crime in the next period. Hence, crimes can be concentrated in one neighbourhood which shares identical characteristics as another neighbourhood.

Marceau (1997) examined the amount of resources devoted to crime deterrence. Resources spent on crime prevention are closely related to the size of police force and the probability of criminals getting caught. Competing jurisdictions are interested in driving out criminals and in attracting mobile capital. The problem faced by a jurisdiction is to choose the amount of resources devoted to crime prevention. Marceau concluded that harmful competition between jurisdictions leads to overdeterrence relative to the optimum level.

Cressman, Morrison and Wen (1998) modeled the strategic actions between property owners, criminals and police using evolutionary game theory. The authors found that public policing tends to crowd out efforts exerted by property owners on private theft prevention. The crime rate therefore increases when the level of public policing is very low and private prevention is being crowded out. As the level of public policing increases and reaches some critical level, crime will be deterred and crime rate falls. Private theft prevention will completely disappear when crime rate reaches zero. Under dynamic evolutionary game theory, individuals behave strategically by imitating and learning from successful past behaviour. This kind of technique may lend important insights to the economics of delinquency since youthful behaviour is often a learning and adaptation

process.

(2) Judicial system and sentencing decisions

The literature on sentencing has gone far into different directions. Crime is sometimes treated as an externality to the society while criminal sentences and fines are thought of as taxes. Concepts such as harm-correcting taxes and welfare weights were introduced. Waldfogel (1993) suggested viewing criminal sentences as harm-correcting taxes, which are treated as endogenous variables. The purpose of his paper is to determine whether current criminal sentences are “efficient” or “just.” While efficient sentencing aims to deter future crime, equity calls for sentencing proportionate to the magnitude of harm imposed by a crime. Using analysis similar to Ramsey’s optimal taxation rule, Waldfogel derived the optimal sentencing condition leading to maximal distortion of criminal behaviour. Data on robbery, larceny and auto theft were applied to determine optimal sentencing for the different crimes and optimal sentences were found to be lower than the actual sentences for all the crimes tested. For instance, optimal sentencing for murder is 5.9 months while actual sentencing is 30.8 months. The next step is to define the condition for proportionally just sentencing by using the concept of implicit harm. Data on robbery, larceny and auto theft were again applied to determine proportionally just sentencing. The result was that murder is over 600 times more harmful than auto theft while actual ratio of sentences for murder to that of auto theft is only 7.7. The conclusion is that actual sentencing seems to be more efficient than just. Waldfogel explains such phenomenon by pointing out that cost of crime and punishment is higher

using just sentencing than optimal sentencing.

In a more recent work, Waldfogel (1996) extended his previous model to infer the welfare weights attached to different population groups from existing sentencing policy. By choosing the level and expenditure on criminal sentencing, the government implicitly places a value on welfare of members of different groups. The approach used is an application of optimal tax theory to determine the direction of welfare-improving sentencing reforms. Different results are obtained for various types of crime. Not surprisingly, women are found to be much more likely than men to be raped, for instance. By estimating the ratio of implicit to actual harms, Waldfogel found that offences are generally "undervalued" by sentencing police. Assault, for example, is extremely "undervalued." For every \$1.00 value of gain from assault, the existing sentencing policy reflects only a \$0.06 value on the crime. By using pooled data, Waldfogel also showed that optimal sentencing requires larger welfare weights to be placed on the utility of black men, white women and youngsters between the age of twelve and nineteen. With the findings of negative welfare weights, the author also suggested Pareto-improving sentencing reforms.

Shavell (1987) argued that socially costly sanctions may not be desirable. He explained that it may not be socially optimal to impose sanctions because certain illegal activities may actually be desirable to society or deterrence may be impossible in some cases. The former case consists of all the illegal activities that are defined socially undesirable by the law enforcement agency such as prostitution. In the market for

prostitution, both the buyers and sellers can be willing and able to provide and purchase the services, and such activities can be considered as desirable in a sense. The latter case can be referred to crimes that are committed "accidentally" or without plots. In such cases, sanctions are not likely to deter such crime from happening in the future and imposing sanctions will simply be a waste of money. Shavell had shown that if the court has perfect information about whether the crime is deterrable and desirable or not, then sanctions should never be imposed in any case. A major argument of Shavell's work is to challenge Becker's assumption that net gain from crime is most likely to be negative by suggesting that illegal acts can be desirable.

Another line of reasoning was offered by Ehrlich (1975) that it is possible for the jurors to make mistake and sanction the innocent. Since the jurors decide on cases by the evidence presented, they can never be perfectly sure about whether an individual is guilty. By applying different measures of elasticities, Ehrlich showed that a one percent increase in the probability of apprehension reduces the expected utility from murder by more than one percent increase in the conditional probability of conviction of murder. Hence it was suggested that the probability of apprehension has a greater deterrent effect on crime than the probability of conviction, which in turn has a greater deterrent effect on the probability of execution. Ehrlich thus concluded that maximal sanction such as capital punishment may not be the optimal policy option to deter crime.

Andreoni (1991) argued that the "reasonable doubt" criterion is often applied by jurors. He explained that as the penalty increases, especially when penalty approaches its

maximal level, jurors tend to apply the "reasonable doubt" criterion more often and become reluctant to convict a person. Knowing the low probability of conviction with maximal level of penalty, individuals may be encouraged to commit crime. Higher sanctions fail to deter crime. The strength of Andreoni's work is that instead of taking level of sanctions and probability of conviction as independent choice variables, the two variables were considered to be dependent on each other.

One stream of the literature focus particularly on plea bargaining. Reinganum (1988) modeled plea bargaining between a prosecutor and a defendant in which there is asymmetric information. The author showed that plea bargains can be used to separate innocent from guilty agents, but the plea bargains offered by prosecutors will only be acceptable to guilty agents who have the highest probability of conviction. Consequently, only innocent people are taken to trial. Reinganum's model, however, does not take into account any institutional or budget constraints on prosecutors.

Roberts (1998) devised a model of plea bargaining that allows for institutional features such as binding budget constraints on prosecutors. The author showed that while plea bargaining conserve resources, the goal may only be accomplished through reduced incentives of true guilt revelation. This happens when police detect leniency in the plea bargaining process and want to counteract such effects by over-representing the strength of the evidence for a given case. This incentive for the police can disrupt and confuse the decision-making process of the jury and judge on determining the guilt or innocence of the defendant. Roberts concluded that the interaction of plea bargaining with binding

institutional constraints on prosecutors lead to more police misrepresentation and higher probabilities of inaccurate convictions. The author also confirmed the earlier finding by Lott (1987a) that the introduction of legal aids benefit the more wealthy defendants.

(3) Other arguments

Following the tradition of Becker, some authors formulated arguments that emphasize the relationship between law enforcement effort and sentencing policies. Recent attempts include the discussion of “beneficial” crime (Shavell, 1987), criminal’s relative sensitivity to changes in certainty than severity of punishment, political economy of crime (Bueno de Mesquita and Cohen, 1995), and temporal structure of criminal behaviour (O’Flaherty, 1998) and sentencing (Boadway, Marceau and Marchand, 1996).

Shavell (1984) reached some interesting conclusions by using the wealth of individuals as an argument. For the case when only fines were used and individuals are endowed with different levels of wealth, optimal fines should be set higher on the wealthier than the less wealthy. On the other hand, if imprisonment is used together with fines, then maximum fines should be applied before using imprisonment with the assumption that fines are socially costless and imprisonment is socially costly.

Neilson (1998) argued that empirical evidence has shown that criminals are more sensitive to changes in certainty than severity of punishment. Increasing the level of punishment increases social loss because criminals are to be moved to a lower utility level; increasing the severity of punishment increases social loss because criminals are risk-averse and face riskier distributions. Under the assumption that conviction of a crime

reduces utility at every wealth level, it then follows that optimal probability of punishment is not equal to one even if it is costless to convict criminals.

Bueno de Mesquita and Cohen (1995) made use of game theory to analyse criminal choice behaviour and provided links to issues on political economy. The authors examined the effects of social welfare programs and attitude towards the government on individuals' decision-making processes between crime and legal work. They showed that increasing the severity of punishment has only weak deterrence while increasing expenditures on law enforcement effort has a greater deterrent effect. Social welfare programs were shown to trigger higher crime rates while training and skill- developing programs can vastly reduce crime rates. By attitude of the government, the authors referred to the perception of different groups of citizens on the fairness of the government. This is essentially an issue on equity. For example, the general belief is that the Democratic Party usually imposes policies favouring the poor and the Republican Party aims at increasing the welfare of the rich. Bueno de Mesquita and Cohen showed that increased trust in the government's fairness reduces the expected level of crime. All their results, however, were derived from a static framework. Further research is required to extend the current analysis to a dynamic setting.

Boadway, Marceau, and Marchand (1996) were among the first to exploit the temporal nature in criminal sanction policy. They suggest that the maximum penalty is not optimal when punishment is applied only after a crime has been committed. Penalty applied after a crime cannot remedy the damage already done to the society. In fact, the

criminal suffers punishment with no one else made better off. Hence, minimum sanction is the optimal policy option in a static framework.

Boadway et al. show that policy implemented in a static framework will be one of the two extreme cases, that is, no sanctions or maximum penalty. If the law enforcement agency is able to commit to the preannounced maximum punishment policy, then no one commits crime and the results resemble those of Becker's. If the law enforcement agency, on the other hand, cannot commit to a maximum punishment policy, then no sanctions will be imposed because punishing the criminal is a Pareto inferior decision. This latter scenario is referred to as "time-consistent" criminal sanctions. Extreme forms of policy prescriptions, however, are not the norm in reality. Boadway et al. resolve the problem by using the dynamic framework. With the dynamic framework, the model better resembles reality as a repeated game when the citizens continue to interact with the law enforcement agency over time. In fact, law enforcement agencies are not likely to impose the time-consistent minimal sanction in a dynamic world because they want to build up a reputation that they are tough on criminals, so that future crime may be deterred. This line of reasoning is formally carried out by using dynamic programming techniques in Boadway et al.'s paper. The authors have shown the possible tradeoffs between lower current welfare from sanctioning criminals and higher benefits of having fewer criminals in the future. With the possible future benefits, a positive yet non-maximal sanction and a positive law enforcement efforts can be obtained.

O'Flaherty (1998) examined criminal choice behaviour in a dynamic setting, in

which individuals are confronted with a long sequence of criminal opportunities O'Flaherty showed that individuals faced with repeated criminal opportunities act differently from those who are confronted with a single opportunity. Probability of getting caught and the severity of penalty no longer serve to deter crime if the time period involved is long enough. With a concave punishment function, additional crime bring less punishment, and more crimes are committed.

Akerlof and Yellen (1994) examined possible crime control methods other than the level of policing effort and punishment. The two authors emphasize the important role of community values in controlling crime where the model developed consists of the interaction between community members, government and criminals. This is one of the few economics of crime studies that has emphasized the importance of social norms and community networks, which are components in the formation of social capital. Criminals maximize their utility by choosing the level of crime subject to the behaviour of community members. The community members consider the benefit from crime-reporting, the fear of gang retaliation, and the perceived fairness of the penalty on criminals. The government decides on the level of police expenditure and punishment with the goal of keeping crime low with a limited budget. The authors argued that the government's optimal strategy to fight crime thus depends on (1) the social cost of crime, (2) the cost of monitoring, (3) neighbourhood income, (4) the fairness of punishment imposed on criminals, and (5) the community's reporting propensity. The maximum level of punishment may not be the optimal policy if the community perceives such policy as

unfair to the criminals and thus leads to lower crime reporting. Hence, the government must take into account community norms when designing crime control policies

The arguments presented so far focus on the analysis of potential criminals, the criminal justice system, and to a lesser extent, potential victim. Rasmusen (1996) extended the analysis to the private sector. According to Rasmusen, employers of private sector respond to individual criminal records when hiring. "Stigma" is used in the analysis to refer to as someone's reluctance to interact with someone else who had a criminal record. This kind of stigma decreases an ex-convict's probability of obtaining legitimate employment.

Rasmusen assumed that stigma from criminalisation can arise through lower wages earned in the private sector. An implication from Rasmusen's assumption is that as an individual accumulated a higher level of criminal capital, a concept that was later formalized by Grogger (1998), the more likely that the individual will spend more time on crime and therefore increasing the probability of their criminal activities detected by police. This kind of chain effects eventually is reflected in lower wages earned in legitimate employment.

Rasmusen analyzed two cases of stigma, moral hazard and adverse selection. In the moral hazard case, crime decreases the productivity of a worker, for example, through shirking by the worker. The author pointed out that multiple equilibria may result in this case depending on the distribution of taste for crime, even though every individual prefers the low-crime to the high-crime equilibrium. In the case of adverse selection, two types of

workers are assumed, namely high-ability and low-ability. While low-ability workers are assumed to be always criminals, high-ability workers choose between committing and not committing crime. The author concluded that multiple equilibria can also result in this case. However, while high-ability workers prefer the low-crime equilibrium, low-ability workers prefer the high crime equilibrium.

The author emphasized the importance of stigma as a mean of crime deterrence to complement the traditional channel of law enforcement efforts. On the one hand, stigma cannot raise revenue like fines. On the other hand, stigma is not costly like imprisonment. Stigma works as a fine on future rents through private sector, which implies that government decisions are less likely to be distorted with the use of stigma. Rasmusen's analysis focuses on economic stigmatization imposed on workers by employers. Although the author mentioned the possibility of social stigma, no formal analysis is provided. Further research is therefore required to explore the issue of social stigma.

2.2 Economics of Delinquency: A Review of the Empirical Literature

Empirical research on the economics of delinquency has been emphasizing the labour market aspects of the problem. Delinquency refers to criminal acts committed by individuals who are under 18 years old while the word crime in general applies to adults over the age of 18. One major problem of the delinquency literature is the lack of theoretical support. No economic decision-making framework has yet addressed issues which are specific to adolescents.

Empirical models concerning the economics of crime appeared long before their theoretical counterparts. A simple regression analysis by Bogen in 1944, for example, tests the relationship between juvenile delinquency and economic conditions. Bogen found that juvenile delinquency increases during boom and decreases during recession. Due to a lack of information, analysis in the early days employed only time series on aggregate data. Since that time, empirical research has become increasingly sophisticated. By using micro data, this stream of research can focus on the effects of various demographic factors on the level of criminal activity and give a more complex picture of factors affecting crime.

Fleisher (1963), for example, categorized youths by age and found evidence that delinquency increases when youth unemployment increases. On the other hand, he also detected a negative relationship between delinquency and youth unemployment among youths who were 16 years of age and younger. His explanation uses a parental supervision argument. Assuming a rise in the youth unemployment rate reflects general bad economic conditions and corresponds to a high overall unemployment rate, parents have more time to take care of their children while being unemployed.

Singell (1967) investigated the relationship between delinquency and unemployment using subjects from Detroit. The simple relationship proposed by Singell is that

$$D = a + BU + u$$

where D represents delinquency, U represents unemployment, and u is the random error

term. Singell conducted two different analysis, one cross-sectional and the other time series. He found that a 1 percent cut in the unemployment rate resulted in a decrease of 1/4 to 1/6 of 1 percent in delinquency rates. Singell's work is important because it uses both cross-sectional and time series analysis from the same set of data.

Ehrlich (1973) tested the partial effects of unemployment and labour force participation rates of urban males between the age of 14 to 24 on crime. He found that participation in property crimes¹ is likely to be determined by opportunities available to offenders and not by age per se. On the other hand, crimes against persons such as robbery and murder appear more likely to be committed by young people. Ehrlich found no significant relationship between unemployment and crime rates for the 14 to 24 age group, possibly due to a high level of voluntary unemployment among young people. He also obtained a negative relationship between the probability of conviction and crime rates

Using Finnish time series data from 1958 to 1992 in the model discussed above. Koskela and Virén (1994) found that the size of the payoff has a positive effect on auto thefts, while the probability of getting caught and the severity of the penalty has negative effects, in both the long run and short run. Marginal income tax rate and sales tax rate of goods were weakly positive correlated with auto thefts in the short run, and had no correlation with auto thefts in the longer run. Koskela and Virén (1997) also found that the number of car thefts increased with the number of cars and hence the returns to car thefts increased. The crime-switching hypothesis is also supported by Finnish evidence on

¹According to the Uniform Crime Reports of the United States published by the FBI, property crimes include burglary, larceny, auto theft, and arson.

car thefts and robberies. As the probability of getting caught and penalty from car thefts increased, the number of robberies increased and vice versa. The authors concluded that the level of punishment and the amount spent on law enforcement efforts can play an important role in deterring auto thefts, but will also increase the number of other types of crime such as robberies.

One of the few Canadian studies on this subject was conducted by Krahn and Hartnagel (1989) on people 15 to 26 years old from Edmonton between late 1984 and early 1985. Among their many other observations, a major finding was that unemployed high school dropouts tend to be more “at risk” of becoming involved in property-related crime. Such a relationship is much weaker in case of violent crime. Using 411 British teenage males, Farrington et al. (1986) also found a positive relationship between unemployment and delinquency. The authors reported that this finding was particularly true for property crimes and more delinquent-prone youths. In addition, they found that delinquency peaked at the year before the minimum school leaving age and there was little difference between crime rates just before leaving school and just after starting full-time employment.

Wright, Cullen and Williams (1997) studied a sample of 1,775 youths between the age of 12 and 18, all of whom were still going to school at the time of the survey. The study examined the relationship between working while in school and delinquent involvement. While most people consider having a part-time job after school as a positive experience for teenagers, the authors show that number of hours worked per week after

school is positively related to delinquent behaviour. Wright et al. pointed out that while education contributes to long term benefits, part-time work provides short term monetary gains. They also argued for the possibility that students who are most committed to their school work are most concerned about the future, and are therefore less inclined to take part-time jobs after school. Studies (for example, Agnew, 1986; Heimer, 1995) have shown that delinquency is positively related to the number of hours employed.

Other studies also find a positive relationship between crime and unemployment among young people. Phillips, Votey, and Maxwell (1972) found that youths who are not working have a significantly higher crime rate than their working counterparts. Youths not in the labour force are also found to have a higher incidence of criminal behaviour than those in the labour force. The interesting finding of Good and Pirog-Good (1987) is that while black teenagers view crime and employment as alternative income-generating sources, white youths tend to use employment to "moonlight" their delinquent activities.

A change in the minimum wage law may influence the number of jobs available to youths and hence the delinquency rate. Hashimoto (1987) suggests that a typical youth spends time on four different kinds of activities, namely schooling, leisure, lawful work, and delinquency activities. Dustman et al. (1997) examine the pattern of how British teenagers divide their time between working and studying. An increase in the minimum wage reduces the time spent by youths in the lawful labour market (Meyer and Wise, 1983), and hence increases their time spent on any or a combination of the other three types of activities. Hashimoto tested the empirical relationship between changes in

minimum wage law and crime committed by youths. He found that an upward adjustment of the minimum wage law increases property-related crime committed by teenagers. Evidence shows that crimes committed by teenagers grow more than those committed by adults whenever there is an increase in minimum wage. Teenage crime seems to be highly sensitive to economic conditions. Chressanthis and Grimes (1990) obtained similar findings and reported a positive relationship between changes in the real minimum wage and teenage criminal activities.

Baron and Hartnagel (1997) examined the relationship between labour market experiences and criminal behaviour among street youths. The “street youths” used in this study had been living on the street without permanent shelter for four months on average. The authors found that an increase in the length in unemployment and a decrease in the income from a legal job both contribute to higher involvement in criminal activities, property and violent crime alike. It was further pointed that youths who experience negative labour market experience coupled with anger toward the social system were even more at risk of committing crime.

Grogger (1998) examined the factors affecting market wages, probability of committing a crime, and labour supply of young men who were neither in school nor the army. This restriction results in a particularly crime-prone population. The author found that higher probability of an individual committing crime in response to lower market wages, dropping out of high school, increased nonlabour income, previous charges, convictions and probations, presence of a brother who was charged, convicted, or on

probations at least once, and urban residency. Grogger's study went beyond the traditional domain of the relationship between crime and unemployment. The author used two variables to examine the effects of criminal capital on the likelihood of committing crime, namely previous convictions of an individual and the individual's brother. According to Grogger, the concept of criminal capital has not been examined analytically in the economics of crime and delinquency literature. A criminal brother, for example, can contribute to one's own criminal productivity by providing information on criminal skills, potential victims and/or law enforcement activities. The concept of criminal capital, such as the presence of delinquent peers, will be dealt with more in depth and carefully analyzed.

Levitt (1998) examined the relationship between punishment and juvenile delinquency using state-level panel data. According to Levitt, the decreasing level of punishment for delinquents since the early 1980s provides an excellent opportunity for testing the economic of crime models such as the one suggested by Becker (1968). One question being raised by Levitt is that whether juvenile and adult crime are substitutes or complements. If criminal opportunities are assumed to be a limited amount, then lower rates of juvenile delinquency will be substituted by more adult crime. On the other hand, if adult criminals serve as role models for juvenile delinquents, then an increase in adult crime will be complemented by an increase in juvenile delinquency. The author find that juvenile and adult crime are substitutes in the case of property crime while there does not exist any significant relationship in the case of violent crime.

Another issue raised by Levitt is the importance of intertemporal choice. To the extent that early delinquent activities serve as the accumulation of crime-related human capital for later crime, harsher punishment for delinquents can lead to fewer adult crimes committed. This is referred to as the deterrence effect of punishment. However, juvenile detention centers can also be a place of meeting other delinquents and thus serve to build up a person's criminal capital. This is referred to as a kind of "stigmatization" by Levitt. Harsher punishment for delinquents may then reduce crime in the short run but increase crime over a longer time horizon. In this latter case, the incapacitation effect outweighs the deterrence effect. The key result obtained by Levitt is that juveniles appear to respond to harsh punishment at least as much as adults. Harsher punishments for juveniles tend to reduce the rates of juvenile delinquency. The author found no significant relationship between the severity of punishment in the last year as a juveniles and adult criminal behaviour. These results suggest that the deterrence and incapacitation effects seem to offset each other or that both effects are small in magnitude.

The effort of Levitt is encouraging on at least two counts. First, the author has shown that the economics of crime models are testable with the availability of relevant data. Second, and more importantly, Levitt has brought in the economic components into a traditional domain of sociology often referred to as the "age-crime debate," which has gained popularity since the 1980s (Blumstein, Cohen and Farrington, 1987, 1988a, 1988b; Gottfredson and Hirschi, 1983, 1990; Jeglum Bartusch et al., 1997; Paternoster and Brame, 1997; Sampson and Laub, 1993). Levitt has pointed out importance of the "age-

crime debate” to the economics of crime models.

Few studies in the economics of delinquency literature have extensively discussed social influences from family, church, and peers on delinquency. One reason for this shortfall is that there is a paucity of theoretical models to encompass these factors. Two of the studies that consider the effects of various social influences are discussed in some detail next.

Viscusi (1986) examined the relationship between market incentives and criminal behaviour. Viscusi’s study is generated by cost-benefit analysis between expected gains from crime and expected legal income for an individual. Using cross-section data that consist of young black males aged 15 to 24, the author formulated three sets of equations to examine the effects of different variables on crime participation, crime income and economic incentives to commit crime.

Viscusi divided the independent variables into different categories and examined their effects on crime participation. Age, level of education, and marital status are found to have no significant impact on crime participation. Individuals who used drugs, marijuana (“pot”), and alcohol are found to be more likely to participate in crime; church attendance, on the other hand, has a weak negative relationship with criminal behaviour. Individuals who had served longer jail time or probation time are found to be more likely to commit crime in a later period. Being in school and having a job are both found to be negatively related with crime participation. Youths are found to participate more in crime if they are gang members or if they reported crime as a serious problem in their

neighbourhoods. The author further included two “economic incentive” variable (1) expected income gap defined as expected annualized earnings from crime minus expected job income (*EXYGAP*) and (2) relative rewards from street crime defined as a dummy variable valued one if the respondent believes he could make more on the street than on a legitimate job and zero otherwise (*YSTREET*). Both of the economic incentive variables are found to be positively related to criminal behaviour.

In the second set of equations, Viscusi used “crime income” as the dependent variable. “Crime-related characteristic” variable such as using drugs, marijuana, and alcohol are found to be positively related with crime income, while church attendance has a negative effect on crime income. Past criminal experiences, indicated by jail and probation time served, are found to have positive impacts on crime income. Being in school or having a legal job are negatively related to crime income while being a gang member and serious crime reported around the neighbourhood tend to increase the level of crime income. *EXYGAP* and *YSTREET* exert positive influence on crime income.

Another set of equations formulated by Viscusi use “economic incentive” variables such as *EXYGAP* and *YSTREET* as dependent variables. Individuals who served longer jail or probation time, reported as gang members and crime as a serious problem in their neighbourhoods, used drugs, marijuana and alcohol are found to have more economic incentives to commit crime. While being in school has a relatively small negative effect on *YSTREET*, it has an extremely powerful negative effect on *EXYGAP*.

Viscusi further pointed that youths who are no longer in school and without a job

exert especially high economic incentives to commit crime. The decision taken by the marginal criminal is likely to be affected by his employment status. The author concluded that economic opportunities have stronger impacts on criminal decisions than law enforcement.

One of the best features of Viscusi's study is the straightforward empirical application of the cost-benefit analysis, that is the formulation of the variable *EXYGAP*. Another strong point of the study is the use of different factors as dependent variables. Such practice has the advantage of examining related problems from different perspectives. The cross-section features of the data limit the opportunities for policy implications. Until the causal relationships embedded in a complex phenomenon such as the problem of crime can be unraveled, little can be said of policy implication. Such problems can only be solved by employing longitudinal data.

Phillips and Votey (1987b) tested the relationship between crime and various economic and demographic variables among American youths. The two major economic variables are earned income and other sources of income obtained by respondents. The two authors concluded that having no or low earned income is not significantly related to the probability of a youth committing crime. Following a modified "work-leisure choice" model as suggested by Hashimoto (1987), variables such as "hours of work" can be used to replace "earned income." Since total time available is fixed, less time can be allocated to criminal activities if the person has a job. Hence, "hours of work," instead of the amount of "earned income," may be more directly related to the probability of a youth

committing crime. Furthermore, "school" takes up a great amount of time for those who stay in school. A variable measuring whether a youth is still in school fits into the modified "work-leisure choice" model.

Another group of variables tested concern "family attitude," such as whether a respondent came from a traditional male-dominated household. Youths coming from male-dominated households were found to be more crime-prone. Youths from households where males and females share household responsibilities, on the other hand, have a lower probability of committing crime. Measures of "family attitude," however, have highly subjective components depending on, for example, interpretations of the survey questions by the respondents. More objective measures may be desirable in this case.

The authors used two "religion" variables, defined as having been brought up with a religion and going to church, to measure the effects of moral compliance on decisions to commit crime. The results from the two "religion" variables imply that strong affiliation to a religion seems to moderate the probability of a youth committing crime. The study of the relationship between religion and crime is not the traditional domain of economics. There are only few exceptions. Lipord, McCormick and Tollison (1993), using aggregate data, found that an increase in church membership significantly reduces the number of violent and nonviolent crimes committed. Freeman (1986) found that churchgoing reduces time spent on delinquency. Freeman further indicated that the significant effects of churchgoing on delinquency are not affected after religious attitude is taken into account. Churchgoing, not religious attitude, is thus the religious factor that affects

behaviour.

“Prior stops by police” aims at testing whether expenditure on law enforcement is effective on preventing delinquency. Phillips and Votey found that prior stops by police tends to moderate the probability of a youth committing crime. The authors, however, only tested the cases of two or fewer prior stops by police. It would be interesting to examine the effects of more, say five, prior stops by police. This would show the differences in effects of police expenditure between chronic offenders and “experimenters” who do not offend on a regular basis.

One major drawback of Phillips and Votey’s model is that they used a linear probability model. Not only is the error term of the linear probability model heteroscedastic and not normally distributed, but such a model cannot guarantee that the predicted probability will lie between zero and one. Other models such as the Logit and Probit models are considered better options.

The existing literature largely supports the idea that higher youth unemployment tends to increase the rate of juvenile delinquency. The “work-leisure choice” explanation is often cited to support this conclusion. Related factors, such as increases in minimum wage, that lower the probability of youths finding jobs will lead to more crime committed by youths. More recent studies tend to use individual micro data instead of aggregate data. Furthermore, the current trend is to include other demographic and sociological variables in addition to the “traditional” economic variables, such as youth unemployment rate and level of earned income. As the empirical literature expands in its domain, there is

a need to expand the theory to include the various social variables. A summary of the empirical literature is provided in Table 1.1

TABLE 1.1
SUMMARY OF EMPIRICAL LITERATURE

Author (year)	Factors affecting youth crime (relationship between factors and youth crime in parentheses)	Type of data/analysis	Country
Bogen (1944)	economic conditions (+)	time series	US
Fleisher (1963)	youth unemployment (+)	time series	US
Singell (1967)	unemployment rate (+)	cross section & time series	US
Phillips, Votey & Maxwell (1972)	participation in labour force (-)	micro	US
Ehrlich (1973)	youth unemployment (?)	cross section	US
Farrington et al. (1986)	youth unemployment (+)	micro	Britain
Viscusi (1986)	drug / alcohol use (+) church attendance (-) probation / jail time (+) employment (-) being in school (-) gang membership (+) criminal neighbourhood (+) economic incentives to commit crime (+)	micro (National Longitudinal Survey of Youth)	US
Good & Pirog-Good (1987)	youth employment (- for blacks, + for whites.)	micro	US
Hashimoto (1987)	increase in minimum wage (+)	time series	US

Phillips & Votey (1987b)	youth having earned income (?) male-dominated household (+) brought up with a religion (-) going to church (-) prior stops by police (-)	micro (National Longitudinal Survey of Youth)	US
Krahn & Hartnagel (1989)	unemployed and high school dropout (+)	micro	Canada
Chressanthis & Grimes (1990)	increase in minimum wage (+)	time series	US
Koskela & Virén (1994)	payoffs from criminal work (+) probability of getting caught (-) severity of penalty (-) marginal income tax rate (+) sales tax rate (+)	time series	Finland
Koskela & Virén (1997)	increased probability of getting caught in another type of crime (+) increased penalty of another type of crime (+)	time series	Finland
Baron & Hartnagel (1997)	decrease in legal income (+) increase in length of unemployment (+)	micro	Canada
Wright, Cullen & Williams (1997)	working while in school (+)	micro	US
Grogger (1998)	market wage (-) high school graduation (-) nonlabour income (+) previous convictions and probations (+) criminal brother (+) urban resident (+)	micro (National Longitudinal Survey of Youth)	US
Levitt (1998)	severity of penalty (-) adult property crime (-)	state-level panel data	US

2.3 Further Research Opportunities and Concluding Remarks

Certain elements and discussions are missing in the economics of crime and delinquency literature. Research opportunities are therefore provided to fill the gaps.

Regarding the empirical research on the economics of juvenile delinquency, the literature is largely *ad hoc* without a theoretical model to explain the decision-making process of adolescents. Activity choices facing adolescents such as schooling are different from those of adults, and thus unique specifications are required. There is a lack of connection between the theoretical literature on economics of crime and the empirical literature on economics of delinquency.

The empirical work on delinquency has emphasized testing the relationship between the rate of delinquency and labour market variables. Other relevant factors which are crucial to the explanation of delinquency have often been ignored by economists and left to be discussed by sociologists and psychologists. As economists, Phillips and Votey (1987b) have examined the relationship between delinquency and a large number of variables including religious beliefs, family attitudes and prior stops by police. The two authors, however, have left out the important variable "school," thus making their research "incomplete" as an attempt to address important issues facing adolescents. Furthermore, a formal theory to explain the decision-making process of adolescents is deemed valuable.

At any rate, the problem of crime is a complex one which no single approach is likely to provide a complete solution. However, the development of a theory that encompasses economic, sociological, and psychological factors is an important step towards a more complete understanding of the problem. To accommodate the recent developments in the economics of delinquency literature, a theory must be equipped to explain the various economic and social forces that affect the delinquency decision. For

example, social institutions such as school, family, and church can be important social networks for an individual to develop human potential and productive capacity. Other social influences such as delinquent friends and criminal relatives may foster the development of criminal skills of an individual. These are important factors in the determination of delinquency that are yet to be developed in the theoretical literature on the economics of crime.

Chapter 3

A Theory of Delinquency

Crime has long been a major problem. Researchers such as John Dilulio, Jr (1996) pointed out that this problem will only get worse with the appearance of a new breed of young, brutal, “stone-cold” predators. In anticipation, governmental bodies are trying to find appropriate policy prescription, especially those related to juvenile delinquency. One problem with using the literature on juvenile delinquency for policy ideas is the lack of a consistent theoretical underpinning for the empirical evidence presented. As pointed out by Hashimoto (1987), adolescents face a more elaborate set of time allocation choices among school, market work, leisure and delinquent activities than most models attempt to encompass. Hashimoto, however, did not formalize his suggestion. Yet, without giving any consideration to schooling, which is so far ignored by the theoretical literature on economics of crime, attempts to model participation in criminal activity will be inadequate. A major goal of this thesis is to fill this gap.

The purpose of this chapter therefore is to construct a theoretical model that encompasses the broader set of activity choices faced by an adolescent and to include the schooling decision in particular. The model discusses not only market determinants of choice, but also social influences on the activity choices of youth. This chapter will discuss how institutions such as family, school, church, and peers affect an adolescent’s time allocation decision through various capital accumulation processes.

Although the empirical literature on the economics of delinquency does provide some evidence for a relationship between various institutions and delinquency, there is no organized explanation of how the two are related. Furthermore, by focussing only on delinquency, the literature in general has overlooked the possibility that the delinquency decision may be part of a joint decision process where time is allocated among various activities. The theory presented here further allows for the explicit choice of not participating in some activities such as delinquency. This is an important theoretical case since the empirical data on delinquency tend to relate to whether individuals have been found to participate in delinquency or not. The theory therefore suggests an important link between institutions, capital accumulation and time use decisions which has not yet been addressed formally in the literature. By formalizing the choice set, I provide the necessary foundation for interpreting the empirical literature on delinquency. This chapter incorporates these ideas by using the concepts of human and social capital (Becker, 1964, 1996; Coleman, 1988). A brief review of the concepts of human and social capital will be provided next, followed by a model explaining the activity choice of adolescents and some brief concluding remarks.

3.1 Human and Social Capital

Human Capital

Human capital refers to the productive resources of an individual that have been accumulated through investments such as education and training. Human capital is

accumulated by using time to participate in activities that lead to improvements in the level of skills and capabilities held by that individual (Coleman, 1988). Increases in human capital increase the productive resources embodied in the individual and therefore allow that individual to realize higher level of income and/or utility (Becker, 1964). The effect of human capital investment on earnings is now an integral part of the economic literature and it is now a standard empirical exercise to use Becker's theoretical formulation to determine the effect of education and schooling on earnings.

One stream of theoretical development in this thesis is to extend human capital theory beyond schooling so that it incorporates more of the time choices facing young people. Keane and Wolpin (1997), for example, suggest five different categories of career choices for young people, but ignore the possibility of criminal work. Most crimes, however, are committed by older teenagers and young adults and this implies that the choice set for adolescents offered by Keane and Wolpin is seriously incomplete. Purely empirical studies that explore the relationship between school, work and crime are relatively numerous (Light, 1998; O'Neill, 1990; Ruhm 1995, 1997; Smith, 1984; Trejo, 1997; Wright, Cullen and Williams, 1997). These studies, however, are *ad hoc*, without an overriding theoretical basis. A theoretical model is required to better explain how policy can better alter the school-work-crime choices of adolescents. To provide the connection between institutions and individuals, I use the concept of social capital.

Social Capital

Social capital refers to individual productive resources accumulated through

interpersonal activities that develop a strong social network between that individual and his/her community. Like other forms of capital, such as physical or human capital, social capital also facilitates other productive activities. Being comfortable when dealing with strangers, for example, lowers the cost of engaging in trade. Unlike other forms of capital, however, social capital can be accumulated only through interactions among individuals (Coleman, 1988). Becker (1996) states that "an individual's stock of social capital depends not primarily on his own choices, but on the choices of peers in the relevant network of interactions."

According to Hagan and McCarthy (1998), social capital is created through participation in different institutions, such as in the family, church, school, and/or neighbourhood. Interactions within these institutions generate trust, obligations, expectations, knowledge and other attributes that contribute to a more cohesive society and allow individuals collectively to act more efficiently in their pursuit of common goals (Putnam, 1995). According to Raider and Burt (1996), social network structures that include contact with more diverse institutions and social groups provide better opportunities for social capital accumulation. This last view, however, is controversial since tensions can be generated within a community with diverse groups due to taste, cultural, and other differences. The generation of opportunities for reciprocity and trust are sometimes considered more likely within a homogenous population (Sugden, 1984).

Recent literature has extended the concept of social capital to criminal capital. Criminal capital refers to the knowledge accumulated and the personal networks developed to promote criminal productivity (Hagan and McCarthy, 1998; Grogger, 1998).

An adolescent who knows better how to interact with other delinquents and criminals will acquire better knowledge of criminal techniques of how to avoid police detection, and thus how to achieve a higher level of criminal productivity.

Grogger (1998) incorporates the concept of criminal capital into a theoretical model that examines the crime-work choice decision of young adults who have permanently left school. Grogger's model, therefore, does not take into account the schooling decision. Furthermore, the risk involved in criminal activities is also ignored in Grogger's model. The model I present includes the schooling decision since the goal is to examine the behaviour of school-age adolescents. Furthermore, the riskiness of criminal activities is taken into account using the probability of getting caught by police. The model presented in this chapter assumes that different activities have different and sometimes multiple effects on the process of social and criminal capital accumulation. Hence, social and criminal capital shape an individual's image and identity and these in turn play an important role in the individual decision making process by altering the payoffs associated with taking a job or participating in delinquency. As will be shown later, social and criminal capital can also affect an individual's decision through more indirect channels.

The concept of social capital is important in that it complements human capital. By considering only human capital, an analysis tends to ignore the ability of other forms of capital accumulation to contribute to the functioning of market processes. This thesis models these dimensions of an adolescent's life to understand better how adolescent behaviour interacts with different institutions. Only by incorporating social capital into a model can the effects of these important institutions in adolescents' lives be analysed so

that their role in the development of law-abiding adults may be better understood by policy makers.

Crime, Work, Schooling, and Capital

Different activities then have different consequences for the various forms of productive capital. Schooling, for example, contributes mostly to the formation of human capital, but the reputation gained by being a good student can also be an important form of social capital. Individuals with a higher level of social capital also earn higher rates of return on their human capital (Raider and Burt, 1996). In such ways, the analysis targets the institutions and networks through which individual stocks of human and social capital can be varied.

The analysis here assumes that the use of time to accumulate capital promotes productivity in either market work, crime, or schooling. All three types of capital are broadly defined to encompass both human and social capital. In the model that follows, the accumulation of work-productive capital serves two functions: (i) it increases the wages earned in market work; and (ii) it increases the opportunity cost to an individual who gets caught from participating in crime.² Crime-productive capital is synonymous with criminal capital, as used in previous literature (Grogger, 1998). The accumulation of

²Evidence provided by Lilia Pezzin (1995) shows that an increase in legal earnings (market wage) increases the opportunity cost of participation in crime and increases the probability of desistance from crime. This provides the link for the assumption that an increase in the level of work-productive capital increases the opportunity cost of getting caught.

crime-productive capital serves three functions: (i) it increases the wages earned from crime; (ii) it decreases the probability of police detection, and (iii) it decreases the returns to more schooling.³ The accumulation of school-productive capital serves two functions (i) it increases the own return to schooling; and (ii) it decreases the value of the wages earned from crime.⁴ The term “market specific informational capital” can be used to refer to the fact that different types of capital can be accumulated to augment an individual’s productivity in any different market sector, that is, in work, crime, and school.

³This is consistent with the theoretical literature that the “stigmatization” from criminal activities can have adverse effects on future earnings (Rasmusen, 1996). John Hagan and Bill McCarthy (1998) show that street activities such as stealing with other street youth (delinquent friends which can be considered as a form of crime-productive capital) discourages subsequent employment, implying a decrease in future earnings. Joan Moore (1991) argues that the delinquent subculture transfers a defiant and subversive attitude first to the school and eventually to the workplace.

⁴W. Kip Viscusi (1986) did a comprehensive study on the relationship between earnings from crime and various factors as discussed in Chapter 2. He formulated a variable EXYGAP defined as expected annual earning from crime minus expected annual earnings from market work. He found a strong negative relationship between school attendance (which can be considered part of the process of school-productive capital accumulation) and EXYGAP, implying an increase in the level of school-productive capital decreases criminal earnings. He also showed a negative relationship between school attendance and opportunities to make illegal income. Liliana Pezzini (1995) showed that young people who received higher education (which again can be considered a result from the process school-productive capital accumulation) are likely to have a lower expected criminal income in the long run. This evidence suggests a negative relationship between actual criminal income and schooling. Although actual and potential criminal earnings may differ, data on potential criminal earnings are difficult to obtain.

3.2 Theoretical Model

The Model

Suppose t_d is the amount of time spent on delinquent activities, t_l is the amount of time spent on market work, t_s is the amount of time spent in school, and t_e is the amount of leisure time. Similarly, let w_d be the market payoff from a unit of time spent in delinquency activity; w_l be the wage for market work⁵; and w_s be the present value per unit of time of the increase in expected earnings (on top of the market wage, w_l) that results from the investment in schooling. Note that the aggregate expected value is directly related to the amount of time spent in school. It follows that $w_d t_d + w_l t_l + w_s t_s$ is the present value of the income flow associated with an individual's allocation of time.

The individual is also assumed to have access to other forms of income and to derive a non-pecuniary return when participating in delinquent activities. In particular, let N represent non-labour income and Ω_j represent the per unit time non-pecuniary return to delinquency as a result of individual heterogeneity. Ω_j adds to the market payoffs obtained from delinquency by individual j .⁶ Ω_j is assumed to have an infinitely negative value for the most extremely crime averse individual and increases through the positive range for a crime lover. Ω_j is used to indicate the individual fixed effects discussed in the next

⁵ w_l in this context is broadly defined as the per unit of time return to market work and can include both monetary and non-pecuniary return.

⁶ Ω_j can be interpreted as a non-pecuniary return reflecting the individual's degree of aversion to delinquency or as a pecuniary return measuring the individual's ability in criminal work. In the latter case, a smaller Ω_j reflects less ability and hence a lower return to each unit of time spent in crime.

chapter.

To represent the various types of capital in the model, let K_i be the level of crime-productive capital; K_l be the level of work-productive capital; and K_s be the level of school-productive capital. In turn, z_i , z_l , and z_s are the institutions or environments that support the accumulation of the respective types of capital, so that $\partial K_k / \partial z_k > 0$, where $k = i, l, s$.⁷ The z 's are represented empirically by activities generated from school, market work, church, family, and with peers.⁸ The amount of time spent in school (t_s) is also considered to have a direct positive effect on the increase in the present value of future earning from investment in schooling (w_s) such that $w_s = w_s(t_s)$ and $\partial w_s / \partial t_s > 0$. This can be considered as a "learning-by-doing" effects. There are increasing returns from specializing in schooling, but these increases diminish as school time increases, $\partial^2 w_s / \partial t_s^2 < 0$.

The model assumes that capital is complementary with labour so that the w 's are increasing functions of their respective K 's, that is, $\partial w_i / \partial K_i > 0$, $\partial w_l / \partial K_l > 0$, and $\partial w_s / \partial K_s > 0$. Furthermore, following Viscusi (1986) and Pezzini (1995), crime and school-productive activities are assumed to affect each other so that w_i is a decreasing function of K_s ($\partial w_i / \partial K_s < 0$) and w_s is a decreasing function of K_i ($\partial w_s / \partial K_i < 0$). This implies that

⁷The different types of capital (K) will also depend on the amount of time invested on work, school, and crime in the past. But given that these decisions have been made already, they influence the current decision only through their embodiment in the K 's.

⁸It will be discussed in more details later that while the z 's are exogenous and directly observable in the empirical analysis, the K 's represent the endogenous capital accumulation processes that are not directly observable.

the accumulation of school-productive capital can decrease the returns (wage) from delinquent activities and the accumulation of crime-productive capital can decrease the returns (wage) from schooling. Hence, w_i , w_l , and w_s can be written as $w_i = w_i [K_i(z_i), K_s(z_s)]$, $w_l = w_l [K_l(z_l)]$, and $w_s = w_s [t_i; K_s(z_s); K_i(z_i)]$. Note that w_s is both a function of t_i and K_s . As will be shown in the first order conditions in more details later, t_i represents a direct “learning-by-doing” effect on w_s from present investment on schooling, while K_s represents the effects of school-productive capital accumulation on w_s from previous time periods. The condition $\partial^2 w_s / \partial K_i \partial K_s < 0$ indicates the extent to which an increase in crime-productive capital can decrease future market wage at the margin by lowering the return to school-productive capital. Similar interpretation can be assumed for $\partial^2 w_i / \partial K_i \partial K_s < 0$. $\partial^2 w_s / \partial t_i \partial K_s < 0$ implies that an increase in crime-productive capital reduces the marginal benefit, in terms of higher future stream of income, of time spent in school. $\partial^2 w_s / \partial t_i \partial K_s > 0$ implies that the accumulation of school-productive capital increases the marginal productivity of time spent in school. An increase in leisure time, t_l , is assumed to contribute positively to the utility of leisure V , $\partial V / \partial t_l > 0$, and diminishing marginal utility, such that $\partial^2 V / \partial t_l^2 < 0$.

The probability that delinquent behaviour will be detected, p , is assumed to be (i) an increasing function of police enforcement spending (m), (ii) an increasing function of time spent on delinquency (t_i), and (iii) a decreasing function of the stock of crime-productive capital (K_i) acquired by an individual. This implies that $p = p[m, t_i, K_i(z_i)]$ with $\partial p / \partial m > 0$, $\partial p / \partial t_i > 0$, and $\partial p / \partial K_i < 0$. Not only is the probability of detection by the police (p) expected to increase with an increase in the time spent on delinquency (t_i), it is

further assumed that $\partial^2 p / \partial t_i^2 > 0$, implying the probability of getting caught increases at an increasing rate as individuals spend more time on delinquency.⁹ The probability of police detection is assumed to decrease as an individual's stock of crime-productive capital increases (delinquents acquire better criminal skills to avoid police detection). Empirically, a vector of variables z_i is constructed such that higher values of z_i represent increases in the stock of crime-productive capital, $\partial K_i / \partial z_i > 0$. Thus, $\partial p / \partial z_i < 0$. The accumulation of crime-productive capital (K_i) should also decrease the marginal probability of getting caught and greater exposure to crime through an increase in the amount of time spent on delinquency (t_i) should increase the probability of getting caught. Hence K_i and t_i can be considered as substitutes in their effects on p so that the cross partial, $\partial^2 p / \partial t_i \partial K_i$, is assumed to be negative. Finally, the cross partial $\partial^2 p / \partial t_i \partial m$ is assumed to be positive since the marginal effect of time spent on delinquency (t_i) on the probability of being caught (p) is higher as the level of police expenditure (m) increases.

Let f be the penalty imposed on an individual who gets caught undertaking delinquent activities, where $f = f[K_i(z_i)]$.¹⁰ f is assumed to be an increasing function of K_i .

⁹This assumption is a convention in the theoretical literature on economics of crime (Ehrlich, 1970). Liliana Pezzin (1995) provides further evidence that increased exposure to crime is associated with a greater number of law enforcement contacts, implying an increase in the probability of getting caught. The same pattern is also detected by others such as Phillips and Votey (1987b).

¹⁰The penalty (f) can be defined as the present value of the discounted losses from getting caught. The penalty can be monetary fines or non-monetary type of penalty such as incarceration converted to a monetary value in terms of opportunity costs. Ehrlich (1973) defines penalty in a way that has become the convention in the economics of crime literature as follows: "the discounted (pecuniary and non-pecuniary) value of the penalty for his [*the criminal's*] entire illegitimate activity and other related losses (including the

so that $\partial f / \partial K_i > 0$, with again z_i being constructed such that higher values of z increase work-productive capital K_i , $\partial f / \partial z_i > 0$. While the penalty could be in the form of a monetary fine, the effect on the penalty can also be thought of as a non-pecuniary cost impose on the delinquent. The more an adolescent has developed a social reputation as a "good kid," the higher is his or her non-pecuniary cost of getting caught.

Putting all these factors together, the individual choice problem can then be written as follows¹¹,

$$(3.1) \quad \max EU(t_c, t_l, t_s, t_e) = p[(w_l + \Omega)t_l + w_l t_l + w_s t_s - f + N] \\ + (1-p)[(w_l + \Omega)t_l + w_l t_l + w_s t_s - N] - V(t_c) .$$

$$s.t. \quad t_c + t_l + t_s + t_e = T ,$$

$$w_s = w_s[t_s; K_s(z_s); K_l(z_l)] ,$$

$$p = p[m, t_l, K_l(z_l)] ,$$

$$and \quad t_l \geq 0 , t_l \geq 0 , t_s > 0 , t_e \geq 0$$

possible loss of his loot)."

¹¹The form of the utility function chosen in this case is additively separable in income (consumption) and leisure. Such formulation is a convention in the theoretical literature on economics of crime (Ehrlich, 1973; Koskela and Virén, 1994; Boadway, Marceau and Marchand, 1996; Grogger, 1998; and many others). While this assumption is not necessary for the model presented here, it simplifies the analysis by eliminating cross effects between income and leisure so that unambiguous theoretical implications can be derived for empirical testings.

where N is non-labour income and T is the fixed amount of time that can be allocated among different activities. The first constraint is the time constraint faced by the individual. This can be substituted directly into the objective function to reduce the number of choice variables to three. The second set of constraints indicates that the individual has the choice of not participating in each of the three remaining time activities delinquency¹², market work and/or schooling.

The utility maximization problem can be solved by the Kuhn-Tucker method, details of which are provided in Appendix 3A. The advantage of the Kuhn-Tucker method is that it solves both for circumstances when an individual chooses to participate in some quantity of all activities (that is, $t_i, t_l, t_s > 0$) and for the case in which the individual chooses not to participate at all in one or more activity (for example, $t_i = 0, t_l, t_s > 0$). The latter case is particularly important for testing the context of my data set since delinquency decision is formulated as a participation versus non-participation choice in the empirical chapters that follow.

The analysis that follows begins by presenting the case where an individual decides to participate and spend some time on all the activities, implying interior solutions for time spent on each activity. A second case is then discussed where the parameters in the model lead to the decision not to participate in delinquency. This implies a corner solution for the delinquency choice problem. This second case is then linked to the distribution of Ω 's

¹²Notice that from the objective utility function, the total returns to delinquency activities depend on both a direct monetary return (w_i) and a non-pecuniary return as a result of individual heterogeneity (Ω) such as thrill derived from the delinquent acts.

across the population and so becomes the basis for the empirical tests that follow in chapters 4 and 5.

If the individual decides to participate in all activities, all the constraints are binding and the first order conditions for each type of time use can be written as follows.

$$(3.2) \quad \frac{\partial EII}{\partial t_i} = w_i + \Omega - \frac{\partial p}{\partial t_i} f - \frac{\partial V'}{\partial t_e} = 0$$

$$(3.3) \quad \frac{\partial EII}{\partial t_i} = w_i - \frac{\partial V'}{\partial t_e} = 0$$

$$(3.4) \quad \frac{\partial EII}{\partial t_s} = w_s + \frac{\partial w_s}{\partial t_s} t_s - \frac{\partial V'}{\partial t_e} = 0$$

From the first order conditions (3.2) to (3.4), the following can be implied.

$$(3.5) \quad \frac{\partial V'}{\partial t_e} = w_i = w_i + \Omega - \frac{\partial p}{\partial t_i} f = w_s + \frac{\partial w_s}{\partial t_s} t_s$$

Condition (3.5) implies that the return from schooling, the last term in the equation, is

equal to the marginal utility of leisure ($\partial V / \partial t_c$) which in turn equals the return from each of the other uses of time.¹³ The first two wages, w_l and w_c , indicate a constant pecuniary return from participation in market and criminal work¹⁴ From equation (3.5), it is implied that the two returns to criminal work, $w_c + \Omega$, overstate the marginal return to criminal work because of the existence of the marginal penalty cost (represented by $\partial p / \partial t_c \cdot t$). Similarly, w_l understates the return to schooling. Here I interpret the term w_l as the effect that time spent in school has on higher future market wages (that is, the human capital effect). Then the term $(\partial w_l / \partial t_s)t_s$ indicates a learning-by-doing effect in which quality of the learning in school improves as more time is spent in school.

Given the parameters of the problem, the system of equations (3.2), (3.3), and (3.4) imply a set of optimal values for t_l^* , t_c^* , t_s^* (implying $t_c^* = T - t_l^* - t_s^*$) that describe the solution to the maximization problem set out in (3.1). The comparative static effect on the system of optimal values of changes in the underlying parameters can be found by totally differentiating equations (3.2) to (3.4).

¹³Equation (5) provides some useful implications for the empirical analysis by comparing the marginal costs and benefits of different time uses. For example, Grogger (1998) compares the marginal return from market work to criminal work. Implications derived from the first order conditions are partial in nature, however. Implications from comparative statics of the underlying variables, on the other hand, have the advantage of yielding general equilibrium results.

¹⁴This kind of direct effect can be interpreted as an increase in wages through human capital accumulation from spending an increasing amount of time in the relevant sector, that is, crime and market work.

Comparative Statics on Wages and Police Expenditure

Comparative statics can be derived for the wages (w_i , w_l , and w_s) by totally differentiating equations (3.2) to (3.4) with respect to the wages that yields the following system:

$$(3.6) \quad \begin{bmatrix} EU_{ii} & EU_{il} & EU_{is} \\ EU_{li} & EU_{ll} & EU_{ls} \\ EU_{si} & EU_{sl} & EU_{ss} \end{bmatrix} \begin{bmatrix} \frac{\partial t_i}{\partial w_i} & \frac{\partial t_l}{\partial w_l} & \frac{\partial t_s}{\partial w_s} \\ \frac{\partial t_i}{\partial w_i} & \frac{\partial t_l}{\partial w_l} & \frac{\partial t_s}{\partial w_s} \\ \frac{\partial t_i}{\partial w_i} & \frac{\partial t_l}{\partial w_l} & \frac{\partial t_s}{\partial w_s} \end{bmatrix} = \begin{bmatrix} -EU_{iwi} & -EU_{ilw_l} & -EU_{isw_s} \\ -EU_{lwi} & -EU_{llw_l} & -EU_{lws} \\ -EU_{swi} & -EU_{slw_l} & -EU_{ssw_s} \end{bmatrix}$$

where $EU_{ii} = \partial^2 EU / \partial t_i^2$, $EU_{il} = \partial^2 EU / \partial t_i \partial t_l$, and so on for the first matrix on the left hand side, $EU_{iwi} = \partial^2 EU / \partial t_i \partial w_i$, $EU_{ilw_l} = \partial^2 EU / \partial t_i \partial w_l$, and so on for the matrix on the right hand side. Comparative statics can then be derived using Cramer's Rule, details of which are provided in Appendix 3B. The general results are summarized in Table 3.1.

TABLE 3.1
RELATIONSHIP BETWEEN WAGES AND TIME USES

	t_i	t_l	t_s
w_i	positive	negative	0
w_l	negative	positive	negative
w_s	0	negative	positive

Results from Table 3.1 show that the per unit of time return from delinquent

activities (w_i) has a positive relationship with the amount of time spent in delinquency, a negative relationship with the amount of time spent in market work, and no relationship with the amount of time spent in school. The per unit of time return from market work is shown to have a positive relationship with the amount of time spent on market work, and negative relationship with both the amount of time spent in delinquency and in school. The present value of the increase in expected earning as a result of increased schooling (w_s) is shown to have a positive relationship with the amount of time spent in school, a negative relationship with the amount of time spent in market work, and no relationship with the amount of time spent in delinquency.

The discussion of wages can be expanded to include other variables such as unemployment rate. The unemployment rate can affect an individual's perceived market wage by affecting the probability of finding a job. By changing an individual's expected market wage, unemployment rate can have an effect on an individual's decision of time allocation on different activities. For example, the higher the unemployment rate, the lower the probability of finding a job, and therefore the lower the expected market wage, $E[w_i]$. This may affect the time allocation decision of an individual.

Comparative statics can also be derived to examine the response of an individual's time allocation decision to changes in the level of police expenditure (m). These comparative statics are derived based on the functional form $p = p[m, t, K_i(z_i)]$. It is assumed that $\partial p / \partial m > 0$, implying that an increase in police expenditure increases the probability of a criminal getting caught. It is further assumed that $\partial^2 p / \partial t \partial m > 0$, implying

that both an increase in exposure time to delinquency and a higher level of police expenditure increase the probability of getting caught. Details of the derivation are provided in Appendix 3B. The general results are summarized in Table 3.2. Results from Table 3.2 show that increased police enforcement spending has a negative effect on the amount of time spent in delinquency, a positive effect on the amount of time spent in market work, and no effect on the amount of time spent in school.

TABLE 3.2
RELATIONSHIP BETWEEN POLICE EXPENDITURE AND TIME USES

	police expenditure (m)
t_i	negative
t_l	positive
t_s	0

Comparative Statics on Institutional Variables

Comparative statics can also be derived for the institutional variables (z_i , z_l , and z_s) by totally differentiating equations (3.2) to (3.4) with respect to the institutional variables.¹⁵ Two cases are presented in the following analysis, the first case where the individual spends time in all wage-earning activities including delinquency, and the second

¹⁵As will be discussed in more detail in the empirical analyses, the Montreal Longitudinal Study contains extensive and detailed data on institutional variables such as influences from school, family, church, and peers. Data on wages, on the other hand, are mostly unavailable except for limited information on market wages. Comparative statics on institutional variables (z's) therefore provide some useful guidelines for empirical testing.

case where the individual spends no time in delinquency.¹⁶

Case I: Participation in delinquency and in all other wage-earning activities

Table 3.3 shows the signs of the direct effect of changes in institutions on the different time uses.¹⁷ An increase in the intensity of crime-productive institutions (z_i), such as an increase in the number of delinquent peers, has a positive effect on the amount of time spent on delinquency (t_i), a negative effect on the amount of time spent in school (t_s), and an ambiguous effect on the amount of time spent on market work (t_l). An important institution that promotes the accumulation of crime-productive capital consists of different types of delinquent peers, such as delinquent friends, criminal adults, delinquent brother(s) and/or sister(s). Influences from other institutions such as a deterioration of the home environment (for example, change from a two-parent to a single parent family may result in a decrease in moral support) can also be crime-productive.¹⁸

¹⁶The case of non-participation in delinquency is useful for empirical analysis in the following chapters where delinquency participation decision is formulated as a 0-1 dummy variable to represent participation versus non-participation.

¹⁷Details of the comparative statics are provided in Appendix 3C.

¹⁸It will be discussed later that each type of institution may have multiple effects by influencing each of the three types of capital.

TABLE 3.3
RELATIONSHIP BETWEEN THE INSTITUTIONAL VARIABLES AND TIME
USES:
PARTICIPATION IN ALL ACTIVITIES¹⁹

	t_i	t_l	t_s
z_i	positive	ambiguous	negative
z_l	negative	positive	negative
z_s	negative	ambiguous	positive

Increases in the investment in work-productive institutions (z_i) is expected to have a negative effect on the amount of time spent on delinquency (t_i), a positive effect on the amount of time spent on market work (t_l), and a negative effect on the amount of time spent in school (t_s). This last result is interesting because it implies that effort spent on investment in market work at an early age can cause a distraction from school and result in less time spent on schooling. The most obvious form of work-productive capital is the learning effect of actual participation in market work. Improvements in the social cohesiveness of the individual's environment, such as living with both biological parents or attending church services can also be work-productive.

¹⁹The relationship between various z 's and t 's from the theoretical implications is based on the assumption that the z 's are continuous variables and that changes in the z 's bring along monotonically continuous changes in t 's at the margin. The definitions of z 's in the empirical analyses, as will be shown in the following chapters, are mostly qualitative and categorical (for example, living with both biological parents versus not living with both biological parents, behaviour of skipping classes as defined by five different categories in terms of frequency). The assumption that the sign of the change does not reverse over the range allows the marginal predictions to provide the testable hypotheses used in the empirical analyses.

Improvements in school-productive institutions (z_s) are expected to have a negative effect on the amount of time spent on delinquency (t_d), a positive effect on the amount of time spent in school (t_s), and an ambiguous effect on the amount of time spent on market work (t_m). Here the variables that can proxy variations in school-productive capital include school activities such as grades obtained in school, class attendance, intention to pursue studies beyond high school, just to name a few. Improvements in the quality of other social influences such as living with both biological parents and church attendance can also be school-productive.

Interpretation of the results from Table 3.3 is straight-forward when changes in an institution unambiguously affect only one particular type of capital. In practice, however, improvements in any one institution may affect more than one type of capital. For instance, an adolescent from a two parent family with better parental supervision can be discouraged from delinquency and encouraged to work hard in both school and in a part-time job. This implies that an improvement in the home environment as measured by being in a two-parent family can have multiple effects on an adolescent's delinquency participation decision.

Suppose, for example, we think of family as an institution and represent family by $\bar{h}$. Then the total effects of family on time spent on delinquency can be shown as follows.

$$(3.7) \quad \frac{\partial t_d}{\partial \bar{h}} = \frac{\partial t_d}{\partial K_s} \frac{\partial K_s}{\partial \bar{h}} + \frac{\partial t_d}{\partial K_m} \frac{\partial K_m}{\partial \bar{h}} + \frac{\partial t_d}{\partial K_d} \frac{\partial K_d}{\partial \bar{h}} < 0$$

Equation (3.7) shows that the overall effect of family on time spent on delinquency ($\partial t_i / \partial \mathbf{b}$) is a combination of three separate effects of the type represented in Table 3.1. The first term on the right hand side of equation (3.7) captures the family's function as a school-productive institution and hence its effect on the level of school-productive capital accumulated and through this the amount of time spent in school. Similarly, the family can also affect the level of work and crime-productive capital at the same time and through these the time spent in delinquency. In the case of a two parent family, all the partial effects are all negative, yielding the implication that two-parent family has an unambiguous overall effect to decrease an adolescent's time spent on delinquency. Note, however, that these results imply that an empirical analysis that attributed all of the effect on delinquency to only one of these channels would likely overstate the strength of that particular connection and misattribute causality for policy planners.

Similar analyses can be performed for each of the other types of social influences such as school, church, market work, and delinquent peers that affect choice.²⁰ This implies that different institutions can have different multiple impacts on different time uses. In this sense the results from Table 3.1 can therefore be seen as a summary of the system effect of only one of three possible channels of connection between different institutions and individual behaviour.

The empirical analyses in the coming chapters use the presence of delinquent peers

²⁰The overall effect for some institutions can be ambiguous depending on the directions implied by each of the partial effects.

to represent higher levels of crime-productive capital and participation in market employment to represent more work-productive capital accumulated. Various forms of school-related activities are used to represent school-productive capital and the influences of family and church categorized as part of school-productive capital.²¹

Case II: Non-participation in delinquency with participation in all other activities²²

The previous analysis assumed that all individuals participated to some degree in all potential activities. However, we know from experience and from the Montreal database that some young people do not participate at all in one or more of these potential activities. The fact that not every individual will choose to engage in delinquent activity is implied by the model ($t_i \geq 0$) and the first order conditions. This case is particularly relevant for empirical studies that model the delinquency decision as a choice between participating or not participating (0-1 dummy variable).

To implement the theoretical model, I assume that there exists a continuum of individuals with different propensities towards crime (Ω) [or inborn tendency²³ to criminality as a stable personality trait]. There then exists a normal distribution of Ω 's in

²¹As mentioned earlier, family and church can also be considered work-productive and/or crime-productive capital. This assumption is made just to keep the analyses in perspective.

²²Case II provides the general methodology for cases with a corner solution. The participation decision with respect to delinquency is used for illustrative purposes.

²³Propensity towards crime may also be a result of abusive and traumatic events experienced during childhood such as sexual assaults and family violence.

the community, denoted by $F(\Omega)$, where $F(\Omega)$ is the cumulative distribution over the Ω 's. Ω can take a large negative value for a person who is extremely crime-averse, and a large positive value for a crime lover, that is $-\infty < \Omega < +\infty$. The decision of delinquency participation depends in part on an individual's value of Ω . A more crime-prone person has a higher value of Ω and faces a higher return from crime compared to other individuals and therefore is more likely to engage in delinquent activities.

The first order conditions derived from case I imply that an individual maximizes utility by equating returns from criminal work to the marginal utility of leisure, a relationship implied by part of condition (3.5) stated as follows.

$$(3.5) \quad \frac{\partial U^*}{\partial l_i} = w_i + \Omega_i - \frac{\partial p}{\partial l_i} f$$

The left hand side of equation (3.5) is the marginal utility of leisure which can be interpreted as the marginal cost of engaging in delinquent activities (MC). The right hand side of equation (3.5) is the marginal benefits of delinquency (MB), which can be explicitly written as $MB = MB(\Omega, z_1, z_2, z_3)$.²⁴ This implies that given different z 's, higher values of Ω lead to higher values of MB, which in turn can be shown to increase the delinquency participation likelihood of individuals.

Suppose, for example we consider an individual with a very low Ω value

²⁴Recall that $w_i = w_i[K_i(z_i); K_x(z_x)]$ and $f = f[K_1(z_1)]$

indicating extreme aversion to crime. For such an individual, the opportunity cost of engaging in delinquency ($\partial V / \partial t_i$) outweighs the marginal benefits of delinquency even at $t_i = 0$, implying that the individual will not participate in delinquency. This is depicted in Figure 1 where the marginal benefit curve (MB_0) is always negative and lies sufficiently below the marginal cost curve that an individual decides not to spend any time on delinquent activities (corner solution)²⁵.

Alternatively, for two individuals who face the same values of w , β and f , the person who has the higher value of Ω receives a higher net benefit from participating in delinquency and hence is more likely to engage in delinquency. A sufficiently high value of Ω can shift the marginal benefit high enough (to MB_1) to intersect with the marginal cost curve at $t_i = 0$, implying that the individual will now spend some positive amount of time on delinquent activities. At the margin, then, there exist some set of individuals whose optimal decision is exactly $t_i = 0$, as indicated by the curve MB_1 . The value of Ω that achieves this result is denoted as $\Omega = \Omega^*$. Therefore, in a distribution of a population of individuals, there exists a set of individuals with $\Omega = \Omega^*$ who are currently indifferent between participating and not participating in delinquency. This is shown in Figure 3.2.²⁶

²⁵This case can also be interpreted as an individual who wants to choose a negative amount of time spent on delinquency as the optimal decision, that is the marginal cost and the marginal benefit curves can theoretically intersect to the left of $t_i = 0$. This implies that the individual may in fact want to spend a positive amount of time on fighting crime.

²⁶The distribution in Figure 3.2 assumes a normal distribution with mean 0. A normal distribution, however, is not essential for the theoretical analysis.

How Ω^* changes with changes in the underlying z 's forms the basis of the comparative statics.

Figure 3.1 Marginal Cost and Marginal Benefit of Delinquency

Figure 3.2 The Distribution of Ω for a Population of Individuals

Individuals with $\Omega > \Omega^*$ participate in delinquent activities. In Figure 3.2, these are the individuals falling in the right-end tail of the cumulative population distribution $F(\Omega)$, implying that the probability of participation in delinquency is $1 - F(\Omega^*)$. Individual with $\Omega = \Omega^*$ in figure 3.2 has $MB = MB_1$ in Figure 3.1.

The discussion of Ω emphasizes that the propensity towards crime can differ among individuals. Hence if each individual's value of Ω is fixed, the height of each individual's MB curve will be affected by different levels of the institutions z . It follows that different values of z will change the delinquency participation decision of each individual and result in a predictable change in the participation rate across the population

as a whole.²⁷

For example, an increase in school involvement has been shown to lower the marginal benefit of delinquency. Hence those individuals who were previously on the margin between choosing whether to participate or not in delinquency will now choose not to participate at all. If all individuals react in the same direction, Ω^* will shift to the right so that the fraction of the population that now participates in delinquency $1-F(\Omega^*)$ falls. This is the basis of the hypotheses tested in the empirical chapters that follow.²⁸

The choice not to participate at all in delinquency adds one further change to the analysis. For an individual whose value of Ω is low enough that he chooses not to engage in delinquency, that is, $t_i = 0$, the probability of getting caught by police (p) does not apply (alternatively, $p = 0$). When the individual continues to participate in market work and schooling, the utility maximization problem becomes

$$(3.8) \quad \max U = w_1 t_1 + w_2 t_2 + N$$

²⁷The direct impact of z on delinquency participation is derived from the first order conditions as implied by equation (3.5). There are also indirect impacts from the different types of capital accumulation process as discussed earlier.

²⁸Alternative implications can also be derived from comparing the marginal effects of z 's on the utility of delinquents and non-delinquents, details of which are provided in Appendix 3D. The convention in the economics of crime literature is to compare the costs and benefits from legitimate and illegitimate work in the individual decision making process (Becker, 1968; Viscusi, 1986; Koskela and Virén, 1994). The analysis provided in Appendix D uses a similar idea to compare the marginal effects from institutions on the utility of delinquents and non-delinquents.

Utility is represented by U , instead of EU , for case II since there is no risk or probability in the outcome. The comparative statics along the t_1 , t_2 margins are provided in Appendix 3E. The results are summarized in Table 3.4.

TABLE 3.4
RELATIONSHIPS BETWEEN THE CAPITAL VARIABLES AND TIME USES
NON-PARTICIPATION IN DELINQUENCY

	t_1	t_2
z_1	positive	negative
z_1	positive	negative
z_2	negative	positive

Note that even though the individual may decide not to participate in delinquent activities, crime-productive capital can still be present and change the uses of time between work, school, and leisure. For example, crime-productive capital generated from its corresponding institutions (z_1) has a positive effect on the amount of time spent in work (t_1) and a negative effect on the amount of time spent in school (t_2). The positive relationship between crime-productive capital and time spent on market work may seem surprising at first. However this is due to the fact that an increase in crime-productive capital reduces the return to schooling (w_s) and the time spent in school (t_2). Furthermore, since diminishing marginal return to leisure discourages an individual from spending all of the freed time on leisure, some of the decreased amount of time spent in school results in increasing the amount of time spent on market work. The increased income received more

than compensates for the loss of potential leisure.

Increases in work-productive capital generated from their corresponding institutions (z_1) have a positive effect on the amount of time spent on market work (t_1), and a negative effect on the amount of time spent in school (t_s). These results are the same as in case I when an individual decides to participate in delinquency.

Lastly, increases in school-productive capital generated from its corresponding institutions (z_s) have a negative effect on the amount of time spent on market work (t_1), and a positive effect on the amount of time spent in school (t_s). The negative relationship between school-productive capital and time spent on market work is due to the positive effect of school-productive capital on the return from schooling (w_s) and the increased amount of time spent in school (t_s), and therefore a decreased amount of time spent on market work.

3.3 Conclusion

The purpose of this chapter has been to develop a theoretical model that examines the choices for the use of time by adolescents including the choices of both school and delinquency participation. Such a formulation of the theory is useful in providing a broader context for understanding the predictions that arise in the economics of delinquency literature. These are largely *ad hoc* at the present time. The theory presented here assumes that each individual maximizes expected utility subject to budget, time and non-negativity constraints. Each individual optimizes by allocating a fixed amount of time

among four potential activities: delinquency, market work, school, and leisure. In addition, each of these choices is made in a context here that time use can create capital. Three types of capital are assumed: (i) crime-productive capital, (ii) work-productive capital, and (iii) school-productive capital.

The capital accumulation process also allows for the influences of various institutions (z 's) to have an impact on the optimal time use decisions of an individual. By construct, the implications for different time use are the same regardless of whether the effects are derived from changes in the capital (K) or changes in the institutions (z) associated with the respective type of capital. However, this chapter focuses on the relationship between time use (t) and institutions (z) because changes in institutions such as family, school, church, and peers are observable, whereas the accumulation of capital is present but unobservable. As will be shown in the empirical analyses, data available to be used as explanatory variables represent different forms of institutions. In addition, it is through its ability to influence institutions that policy can influence delinquency rates. By knowing the relative effects of different institutions on delinquency, policy may be better directed at this social problem.

Application of the time allocation model to delinquency is interesting because individuals can choose to spend no time on some of the four potential activities. To present these possibilities, the analysis began with Case I, where the individual decides to spend some amount of time on each activity (interior solutions for all activities). Comparative static results are then derived to show the predicted effects of changes in the

intensity of different types of institutions on the various time uses

A second case (case II) then follows in which non-participation in delinquency arises. In this case the analysis is structured by having the delinquency participation decision determined by whether the interaction between the marginal cost (MC) and marginal benefit (MB) of delinquency involvement takes place in the positive range (that is, $t_i > 0$). MB is a function of the different institutions (z) and individual propensity towards crime (Ω). A person with either a higher propensity towards crime or more ability in committing that crime derives a higher marginal benefit from delinquency participation and is therefore more likely to engage in delinquent activity. Individuals who are either more crime-averse or have a lower propensity towards crime face a relatively low marginal benefits from delinquency participation and hence are less likely to engage in delinquency. Individuals who are indifferent between participation and non-participation in delinquency are defined as having a $\Omega = \Omega^*$. These individuals then form the margin so that influence on them from institutions predict changes in the delinquency participation rate across the community. In this way, the theoretical analysis of this chapter provides the hypotheses for empirical testing that are presented in the following chapters.

Appendix 3A

Since the time constraint is always binding, it can be directly substituted into the objective leisure function V. The problem can therefore be rewritten as follows.

$$(3A1) \quad \max EU = p[(w_l + \Omega)t_l + w_l t_l + w_s t_s - f + N] + (1-p)[(w_l + \Omega)t_l + w_l t_l + w_s t_s + N] \\ + V(T - t_l - t_l - t_s) + \lambda_l t_l + \lambda_l t_l + \lambda_s t_s$$

$$s.t. \quad w_s = w_s[t_s; K_s(z_s); K_s(z_s)] ,$$

$$and \quad p = p[m, t_l, K_l(z_l)],$$

where the λ 's are the Lagrange multipliers. The first order conditions can be derived as follows,

$$(3A2) \quad \frac{\partial EU}{\partial t_l} = \begin{cases} w_l + \Omega_l - \frac{\partial p}{\partial t_l} f - \frac{\partial V}{\partial t_l} + \lambda_l = 0 & \text{if } t_l > 0 \\ w_l + \Omega_l - \frac{\partial p}{\partial t_l} f - \frac{\partial V}{\partial t_l} + \lambda_l \leq 0 & \text{if } t_l = 0 \end{cases}$$

$$(3A3) \quad \frac{\partial EU}{\partial t_l} = \begin{cases} w_l - \frac{\partial V}{\partial t_l} + \lambda_l = 0 & \text{if } t_l > 0 \\ w_l - \frac{\partial V}{\partial t_l} + \lambda_l \leq 0 & \text{if } t_l = 0 \end{cases}$$

$$(3A4) \quad \frac{\partial EU}{\partial t_s} = \begin{cases} w_s + \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial t_s} t_s - \frac{\partial V}{\partial t_s} + \lambda_t = 0 & \text{if } t_s > 0 \\ w_s + \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial t_s} t_s - \frac{\partial V}{\partial t_s} + \lambda_t \leq 0 & \text{if } t_s = 0 \end{cases}$$

$$(3A5) \quad \frac{\partial EU}{\partial \lambda_t} = \begin{cases} t_t = 0 & \text{if } \lambda_t > 0 \\ t_t > 0 & \text{if } \lambda_t = 0 \end{cases}$$

$$(3A6) \quad \frac{\partial EU}{\partial \lambda_t} = \begin{cases} t_t = 0 & \text{if } \lambda_t > 0 \\ t_t > 0 & \text{if } \lambda_t = 0 \end{cases}$$

$$(3A7) \quad \frac{\partial EU}{\partial \lambda_s} = \begin{cases} t_s = 0 & \text{if } \lambda_s > 0 \\ t_s > 0 & \text{if } \lambda_s = 0 \end{cases}$$

The first order conditions show that when time spent on an activity is greater than 0 (the case of interior solution), then the corresponding λ is equal to zero and vice versa.

Appendix 3B

This appendix provides the comparative statics results between various types of wages (w) and different uses of time.

Define φ , γ , ζ , and ψ as follows.

$$\varphi = \frac{\partial^2 p}{\partial l_1^2} f > 0$$

$$\gamma = \frac{\partial^2 w_s}{\partial l_s^2} l_s < 0$$

$$\zeta = 2 \frac{\partial w_r}{\partial l_1} > 0$$

$$\psi = \frac{\partial^2 l_r}{\partial l_c^2} < 0$$

Comparative static results can then be derived as follows.

$$(3B1) \quad \frac{\partial l_1}{\partial w_1} = \frac{-\psi(\gamma + \zeta)}{J_1} > 0$$

$$(3B2) \quad \frac{\partial I_i}{\partial w_i} = \frac{\psi(\gamma+\zeta)}{J_i} < 0$$

$$(3B3) \quad \frac{\partial I_i}{\partial w_s} = 0$$

$$(3B4) \quad \frac{\partial I_i}{\partial w_i} = \frac{\psi(\gamma+\zeta)}{J_i} < 0$$

$$(3B5) \quad \frac{\partial I_i}{\partial w_i} = \frac{(\gamma+\zeta)(\varphi-\psi) + \varphi\psi}{J_i} > 0$$

$$(3B6) \quad \frac{\partial I_i}{\partial w_s} = \frac{-\varphi\psi}{J_i} < 0$$

$$(3B7) \quad \frac{\partial I_i}{\partial w_i} = 0$$

$$(3B8) \quad \frac{\partial t_s}{\partial w_l} = \frac{-\phi\psi}{J_l} < 0$$

$$(3B9) \quad \frac{\partial t_s}{\partial w_s} = \frac{\phi\psi}{J_l} > 0$$

$$(3B10) \quad \frac{\partial t_l}{\partial m} = \frac{\frac{\partial^2 p}{\partial t_l \partial m} \psi (\gamma + \zeta)}{J_l} < 0$$

$$(3B11) \quad \frac{\partial t_l}{\partial m} = \frac{-\frac{\partial^2 p}{\partial t_l \partial m} \psi (\gamma + \zeta)}{J_l} > 0$$

$$(3B12) \quad \frac{\partial t_s}{\partial m} = 0$$

Note that the implications from equations (3B10) and (3B11) are driven by the cross partials $\partial^2 p / \partial t_l \partial m > 0$, implying that an increase in the time spent on delinquency (t_l) and an increase in the level of police spending (m) reinforce each other in increasing the probability of a delinquent getting caught at the margin.

J_1 is the determinant and

$$J_1 = -\varphi\psi(\gamma + \zeta).$$

By assuming concavity of the function, $J_1 < 0$ is guaranteed, implying that $(\gamma + \zeta) < 0$

Appendix 3C

It is most obvious that factors such as grades obtained from school, intention to pursue studies beyond high school, and effort spent in doing homework are school-related and therefore are part of the school-productive capital. Factors such as the amount of hours spent on market work and the level of accumulated market work experience are obviously work-productive capital. Influences from other institutions such as family, church, and peers are perhaps more difficult to categorize. For example, an adolescent who lives with both biological parents can be better supervised on school work (K_s), discouraged from delinquent activities (K_r), and encouraged to spend time productively by getting a part time job (K_j). Similar interpretations can be applied to any type of institutions such as “school,” “church,” and “peers.” Therefore, the analysis here assumes that any social institution can serve different functions in affecting different types of capital such that

$z_i = (\text{school, market work, family, church, peers});$

$z_i = (\text{school, market work, family, church, peers});$ and

$z_i = (\text{school, market work, family, church, peers}).$

Define ϕ , γ , ζ , and ψ as in Appendix 3B, comparative static results can be derived as follows,

$$(3C1) \quad \frac{\partial I_1}{\partial z_1} = \frac{\psi(\gamma+\zeta) \left[\frac{\partial^2 p}{\partial I_1 \partial K_1} f - \frac{\partial w_1}{\partial K_1} \right] \frac{\partial K_1}{\partial z_1}}{J_1} > 0$$

$$(3C2) \quad \frac{\partial I_1}{\partial z_1} = \frac{\psi(\gamma+\zeta) \left[\frac{\partial p}{\partial I_1} \frac{\partial f}{\partial K_1} + \frac{\partial w_1}{\partial K_1} \right] \frac{\partial K_1}{\partial z_1}}{J_1} < 0$$

$$(3C3) \quad \frac{\partial I_1}{\partial z_1} = \frac{-\psi(\gamma+\zeta) \frac{\partial w_1}{\partial K_1} \frac{\partial K_1}{\partial z_1}}{J_1} < 0$$

$$(3C4) \quad \frac{\partial I_1}{\partial z_1} = \frac{-\psi\phi \left(\frac{\partial w_1}{\partial K_1} + \frac{\partial^2 w_1}{\partial I_1 \partial K_1} I_1 \right) \frac{\partial K_1}{\partial z_1} - \psi(\gamma+\zeta) \left(\frac{\partial^2 p}{\partial I_1 \partial K_1} f - \frac{\partial w_1}{\partial K_1} \right) \frac{\partial K_1}{\partial z_1}}{J_1} ,$$

$$(3C5) \quad \frac{\partial I_1}{\partial z_1} = - \frac{(\gamma+\zeta) \left[\phi \frac{\partial w_1}{\partial K_1} - \psi \frac{\partial w_1}{\partial K_1} - \psi \frac{\partial p}{\partial I_1} \frac{\partial f}{\partial K_1} \right] \frac{\partial K_1}{\partial z_1}}{J_1} > 0$$

$$(3C6) \quad \frac{\partial I_1}{\partial z_1} = \frac{-\psi\phi \left(\frac{\partial w_1}{\partial K_1} + \frac{\partial^2 w_1}{\partial I_1 \partial K_1} I_1 \right) \frac{\partial K_1}{\partial z_1} + \psi(\gamma+\zeta) \frac{\partial w_1}{\partial K_1} \frac{\partial K_1}{\partial z_1}}{J_1} ?$$

$$(3C7) \quad \frac{\partial t_s}{\partial z_s} = \frac{\psi\phi\left(\frac{\partial w_s}{\partial K_s} + \frac{\partial^2 w_s}{\partial t_s \partial K_s} t_s\right) \frac{\partial K_s}{\partial z_s}}{J_1} < 0$$

$$(3C8) \quad \frac{\partial t_s}{\partial z_s} = \frac{-\psi\phi \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial z_s}}{J_1} < 0$$

$$(3C9) \quad \frac{\partial t_s}{\partial z_s} = \frac{\psi\phi\left(\frac{\partial w_s}{\partial K_s} + \frac{\partial^2 w_s}{\partial t_s \partial K_s} t_s\right) \frac{\partial K_s}{\partial z_s}}{J_1} > 0$$

Implication for equation (3C1) partly depends on the cross partials $\partial^2 p / \partial t_s \partial K_s < 0$.

implying that while an increase in time spent on delinquency (t_s) increases the probability of getting caught at the margin, an increase in the level of criminal capital (K_s) enhances criminal skill and decreases the probability of getting caught at the margin. The

implication for equation (3C7) is partly motivated by the cross partials $\partial^2 w_s / \partial t_s \partial K_s < 0$.

implying that individuals who have higher level of crime-productive capital benefit less from time spent in school at the margin. The implication for equation (3C8) is generated

partly by the cross partials $\partial^2 w_s / \partial t_s \partial K_s > 0$, implying that individuals who have higher level of school-productive capital are more productive with their time spent in school at the margin.

J_1 is the determinant and

$$J_1 = -\psi(\gamma + \zeta)$$

By assuming concavity of the function, $J_1 < 0$ is guaranteed, implying that $(\gamma + \zeta) < 0$.

Appendix 3D

As implied by the different utility functions from the two cases presented in this chapter, social influences and capital accumulation can have different effects on utility between participation and non-participation in delinquency. The purpose of this section is to compare these differences. The impacts from various institutions and capital on utility can be derived by applying the envelope theorem²⁹. In the following analysis, superscripts I and II are used to indicate optimal choice values for cases I and II respectively. Recall that EU and U are used to represent the objective utility functions of cases I and II respectively.

The effects of crime-productive capital and social influences on utility can be derived as follows.

$$(3D1) \quad \left\{ \begin{array}{l} \text{CASE I:} \quad \frac{\partial EU}{\partial z_t} = \frac{\partial w_s}{\partial K_t} \frac{\partial K_t}{\partial z_t} t'_s + \frac{\partial w_t}{\partial K_t} \frac{\partial K_t}{\partial z_t} t'_t - \frac{\partial p}{\partial K_t} \frac{\partial K_t}{\partial z_t} f \\ \text{CASE II:} \quad \frac{\partial U}{\partial z_t} = \frac{\partial w_s}{\partial K_t} \frac{\partial K_t}{\partial z_t} t''_s \end{array} \right\}$$

Equation (3D1) shows that case I has the additional effects associated with time spent on delinquency and penalty from getting caught. The combination of these two additional

²⁹Let M be the function that gives the maximized value of the objective function. According to the envelope theorem, the derivative of M with respect to a parameter (in this case z) is given by the partial derivative of the objective utility function (EU or U in this case) with respect to the parameter (z) evaluated at the optimal values of the choice variables (in this case t's). For a more detailed discussion, see Varian (1992), p.45.

effects has a positive effect on the utility (EU) associated with case I, implying that there is an incentive for delinquents to accumulate crime-productive capital and hence spend more time on delinquency. The first term on the right-hand side for both cases is negative since crime-productive capital (K_1) has an adverse effect on returns from schooling (w_1). This also implies that the total effect of crime-productive capital on utility is negative for non-delinquents (case II) and that non-delinquents have the tendency to stay away from social influences that are crime-productive. The magnitudes of this negative effect for the two cases, however, are not directly comparable since the optimal values for time spent in school (t_1) may differ for the two cases.³⁰ If $t_1^I < t_1^{II}$, then $\partial EU / \partial z_1 > \partial U / \partial z_1$, implying that crime-productive institutions and capital have a more positive impact on the utility of delinquents than that of non-delinquents, and have the tendency to encourage delinquency participation.

The effects of work-productive capital and social influences on utility can be derived as follows,

$$(3D2) \quad \left\{ \begin{array}{l} \text{CASE I:} \quad \frac{\partial EU}{\partial z_1} = \frac{\partial w_1}{\partial K_1} \frac{\partial K_1}{\partial z_1} t_1^I - p \frac{\partial f}{\partial K_1} \frac{\partial K_1}{\partial z_1} \\ \text{CASE II:} \quad \frac{\partial U}{\partial z_1} = \frac{\partial w_1}{\partial K_1} \frac{\partial K_1}{\partial z_1} t_1^{II} \end{array} \right\}$$

³⁰Since delinquents spend their time on an additional activity (delinquency) compared to non-delinquents, it is likely (though not certain) that they spend less time on schooling than their non-delinquent counterparts, that is, $t_1^I < t_1^{II}$.

From equation (3D2), it can be observed that delinquents (case I) face an additional psychic penalty cost ($\partial f / \partial K_1$) when the level of work-productive capital increases. This can be explained as “stigma” faced by a delinquent who has a good job prospects (Rasmusen, 1996). This imposes a negative effect on the utility of the delinquents which does not exist in case II for non-delinquents. The first term on the right-hand side of both cases indicate a positive effect of work-productive capital on utility through a higher market wage made possible in the work-productive capital accumulation process, implying that the total effect of work-productive capital on the utility of non-delinquents is positive. The magnitudes of this positive effect, however, are not directly comparable for the two cases since the optimal values of time spent on market work may differ between cases I and II. If $t_1^I < t_1^{II}$, then $\partial EU / \partial z_1 < \partial U / \partial z_1$, implying that work-productive institutions and capital have a more positive impact on the utility of non-delinquents than that of delinquents, and have the tendency to discourage delinquency participation.

The effects of school-productive capital and social influences on utility can be derived as follows,

$$(3D3) \quad \left\{ \begin{array}{l} \text{CASE I:} \quad \frac{\partial EU}{\partial z_s} = \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial z_s} t_1^I + \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial z_s} t_1^I \\ \text{CASE II:} \quad \frac{\partial U}{\partial z_s} = \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial z_s} t_s^{II} \end{array} \right\}$$

Equation (3D3) shows that case I (delinquents) has an additional negative effect associated

with the adverse effect of school-productive capital (K_s) on the returns to delinquency (w_d). This effect has a negative impact on the utility of delinquents, implying that there is an incentive for delinquents to avoid the accumulation of school-productive capital. The first term on the right-hand side for both cases is positive since school-productive capital (K_s) has a direct positive effect on returns from schooling (w_s). This also implies that the total effect of school-productive capital on utility is positive for non-delinquents (case II). The magnitudes of this positive effect for the two cases, however, are not directly comparable since the optimal values for time spent in school (t_s) may differ for the two case as mentioned earlier. If $t_s^I < t_s^II$, then $\partial EU / \partial z_s < \partial U / \partial z_s$, implying that school-productive institutions and capital have a more positive impact on the utility of non-delinquents than that of delinquents, and have the tendency to discourage delinquency participation.

The results therefore show that while crime-productive institutions tend to encourage delinquency participation, work-productive and school-productive institutions tend to discourage delinquency participation under the assumption that $t_s^I < t_s^II$ and $t_d^I > t_d^II$.

Appendix 3E

Using the definitions of φ , γ , ζ , and ψ as defined in Appendix 3A, the following comparative statics results can be derived for the case of non-participation in delinquency. Comparative static results can then be derived as follows.

$$(3E1) \quad \frac{\partial t_l}{\partial z_s} = \frac{\psi \left(\frac{\partial w_s}{\partial K_l} + \frac{\partial^2 w_s}{\partial t_s \partial K_l} t_s \right) \frac{\partial K_l}{\partial z_s}}{J_{ll}} > 0$$

$$(3E2) \quad \frac{\partial t_l}{\partial z_l} = - \frac{(\gamma + \zeta + \psi) \frac{\partial w_l}{\partial K_l} \frac{\partial K_l}{\partial z_l}}{J_{ll}} > 0$$

$$(3E3) \quad \frac{\partial t_l}{\partial z_s} = \frac{\psi \left(\frac{\partial w_s}{\partial K_s} + \frac{\partial^2 w_s}{\partial t_s \partial K_s} t_s \right) \frac{\partial K_s}{\partial z_s}}{J_{ll}} < 0$$

$$(3E4) \quad \frac{\partial t_s}{\partial z_s} = \frac{-\psi\left(\frac{\partial w_s}{\partial K_s} + \frac{\partial^2 w_s}{\partial t_s \partial K_s} t_s\right) \frac{\partial K_s}{\partial z_s}}{J_{II}} < 0$$

$$(3E5) \quad \frac{\partial t_s}{\partial z_s} = \frac{\psi \frac{\partial w_s}{\partial K_s} \frac{\partial K_s}{\partial z_s}}{J_{II}} < 0$$

$$(3E6) \quad \frac{\partial t_s}{\partial z_s} = \frac{-\psi\left(\frac{\partial w_s}{\partial K_s} + \frac{\partial^2 w_s}{\partial t_s \partial K_s} t_s\right) \frac{\partial K_s}{\partial z_s}}{J_{II}} > 0$$

The implications for equations (3E1) and (3E4) are partly motivated by the cross partials $\partial^2 w_s / \partial t_s \partial K_s < 0$, implying that individuals who have higher level of crime-productive capital benefit less from time spent in school at the margin. The implications for equations (3E3) and (3E6) are partly generated by the cross partials $\partial^2 w_s / \partial t_s \partial K_s > 0$, implying that individuals who have higher level of school-productive capital are more productive with their time spent in school at the margin.

J_{II} is the determinant and

$$J_{II} = \psi(\gamma + \zeta) > 0$$

which satisfies the concavity property of the function.

Chapter 4

An Empirical Study of Delinquency

The purpose of this chapter is to examine empirically the effects of various capital-generating institutional variables on delinquent behaviour using data from the Montréal Longitudinal Study. The study was launched in 1984 when all the individuals in the sample were 6 years old. The database available for the purpose of this dissertation spans from the period 1988 to 1995 when the sample population was between 10 to 17 years of age.

The discussion will begin with the examination of cross-sectional data from 1995. Data on self-reported delinquency will be used as the dependent variable, a 0-1 dummy variable. The logit model will be used for estimation purposes. The effects of school, family, church, work, and peers on delinquent involvement will be examined. A fixed effects model will then be estimated under panel data analysis to examine the importance of individual propensity for crime and/or control for individual heterogeneity. Estimation results will be compared between the cross-sectional and the panel data analyses.

The last set of estimations in this chapter will use the bivariate probit model to conduct a two-equation analysis. The two dependent variables used under this model are self-reported violent offences and property crimes. The purpose of this last exercise is to examine whether the various factors have different impacts on the two different types of offences.

4.1 The Montréal Study

Data

This chapter uses data from a research project conducted by the University of Montréal. The Montréal Longitudinal Study was launched in the spring of 1984, when the subjects were attending kindergarten at the Montréal Catholic School Commission which covered mostly French-speaking students (Tremblay et al., 1994). To obtain a high base rate of boys at risk for delinquent behaviour and "to control for cultural effects," subjects were included only if (i) male, (ii) both parents were born in Canada with French as their mother tongue, and (iii) the subject came from a family with low socioeconomic status

Cultural and sex differences cannot be analysed using the data due to the attempt of the study to create a homogenous population. The median and mean family income at age 10 in 1988 was about \$25,000 and \$30,000 (Canadian dollars) respectively, compared with a median income of \$44,000 (Canadian dollars) for couples with children in Canada in 1987. After eliminating boys whose families refused to participate further in the study, the sample size made available for the purpose of this dissertation is 1,069, where the boys were all 17 years old in 1995.

Data from the Montréal Longitudinal Study have been used to test different

phenomena throughout the years, mostly within the context of psychology. Some of the studies which have made use of the Montréal data examine the prediction of male antisocial behaviour from preschool behaviour (Tremblay et al., 1994), the relationship between peer characteristics and juvenile delinquency in early adolescence (Vitaro et al., 1997), and the impact of family transition such as divorce and remarriage on deviant behaviour development (Pagani et al., 1998). These earlier studies focus on the behavioural characteristics of young children and early adolescence. As the data collection process continues, data gathered when the boys started to enter late adolescence are more relevant for the study of juvenile delinquency.³¹

Questionnaires were distributed to the boys every year, and also to their parents and teachers in earlier years. The content of the survey contains extensive information on health, emotions, work, school, friends, family, leisure activities, and delinquency of the subjects. Most questions are in the multiple-choice format so that answers are coded in a categorical format, with a few exceptions such as the actual number of hours of work per week.

A general criticism on survey studies such as our Montréal Longitudinal Study is that the self-reported delinquent behaviour can be unreliable. This is often called the problem of under-reporting and over-reporting. Measurement error, through such things

³¹Various studies and statistics have shown that involvement in criminal activities peaks at the age of 16 to 18, depending on the type of crime discussed.

as inaccurate reporting, decreases the precision with which the effect of self-reported delinquency on official delinquency can be measured. Moreover, systematic bias in the recording of self-reported behaviour can also affect the reported results.

The survey method used by the Montréal Longitudinal Study has attempted to minimize the size of potential measurement errors³² by cross-checking the information provided by the adolescents themselves, their parents and teachers whenever possible. Survey participants are also assured of individual anonymity. The names of individuals were never utilized by any researcher except for the purpose of matching records. By following such accepted survey methods, the questionnaires can be expected to generate unbiased and reasonably reliable answers from individuals. The data-base covers answers to 27 self-reported delinquency items collected from a questionnaire about school, family, friends, and leisure activities. The 27 items are also not explicitly indicated as questions about delinquent behaviour and are widely spread out in the questionnaire. Such carefully designed survey practices help to minimize moral hazard in self-reported answers. Only selected items from the survey are used for the purpose of this paper.

The model

The model estimated here is based on the theoretical model presented in the last

³²For more detailed description of survey methods used in the Montréal Longitudinal Study, see Tremblay et al. (1994).

chapter. Since data are unavailable for the number of hours spent on delinquency as defined in the last chapter, the dependent variable takes a value of one for the presence of self-reported delinquent behaviour (sjd) and a value of zero otherwise. The database provides information on 27 types of self-reported delinquent behaviour. The analysis here uses 10 of the 27 items which are considered to be more serious offences to formulate the measure sjd .³³

Let sjd^* be the number of hours spent on delinquent activities such that

$$(4.1) \quad sjd^* = t_i[K_1(z_i), K_2(z_i), f, N, s].$$

Hence sjd^* is the latent variable related to sjd , a relationship which is deemed necessary for the logit analysis in the following discussion. sjd^* is an unobservable continuous variable upon which the observable variable sjd depends in the following manner:

$$(4.2) \quad sjd = \begin{cases} 1 & \text{if } sjd^* > 0 \\ 0 & \text{if } sjd^* = 0 \end{cases}$$

It follows that an individual will engage in criminal activities ($sjd=1$) if the expected utility received from committing a crime is higher than that from not committing a crime

³³The formulation of sjd is intended to include only offences that can be regarded as violent behaviour or property crime. Behaviour such as smoking marijuana, drinking beer, and getting drunk will be discussed later.

($\text{sjd}^* > 0$). The independent variables encompass influences from social institutions such as school, work, family, religion, and peers.

While Phillips and Votey (1987b) employed a linear probability model in their estimation, this paper will use the logit model for a more accurate specification. A logit model is more appropriate since a linear probability model cannot guarantee a predicted probability between 0 and 1, and also suffers from the problem of heteroskedasticity in the error term. The logit model will be estimated by maximizing the log-likelihood function that follows,

$$(4.3) \quad \ln L = \sum \left[\text{sjd}_i \ln \left[\frac{\exp(BX)}{1 + \exp(BX)} \right] + (1 - \text{sjd}_i) \ln \left[\frac{1}{1 + \exp(BX)} \right] \right]$$

where BX is defined as follows,

$$(4.4) \quad BX = \beta_0 + \sum \beta_m z_m + \sum \beta_n \psi_n$$

K is a vector of capital-generating institutional variables, and ψ is a vector of other relevant variables. The β 's are the respective coefficients of the explanatory variables. The β 's in the logit model measure the marginal effects on the log-odds. For example, β_m indicates how the log-odds in favor of being a delinquent change when z_m is changed by a unit.

Definitions of the dependent and explanatory variables are summarized in Tables 4.1A and 4.1B respectively. See Appendix 4A for a detailed description and frequency distribution from the original survey questions in French. Let the different forms of delinquency be d_i where $i = 1, \dots, n$ to indicate n different types of delinquency. In the original survey, involvement in different types of delinquency are recorded as 1 = never (jamais), 2 = once or twice (une ou deux fois), 3 = many times (plusieurs fois), and 4 = frequently (très souvent). I recoded these delinquency items as 0-1 dummy variables (0 = never, 1 = once or more). The mathematical formula for “sjd,” for example, is denoted by $sjd = \max (d_1, \dots, d_n)$ where $d_i = 0$ or 1. The self-reported delinquent behaviour used in this chapter are “gangfight,” “strongarm,” “weapon,” “beatup1,” “beatup2,” “steal100,” “stealbike,” “stolengood,” “breakenter,” and “setfire.”

One-year lagged values are used on all the capital-generating institutional variables to account for the problem of endogeneity. Several variables are used to proxy school-productive capital generating institution (z_t in Chapter 3). Percentage scores in “French” and “math” obtained in the previous school year is a measure of school-productive capital accumulated to date. “Motivation” to pursue study beyond high school in the previous school year is also considered an incentive to accumulate school-productive capital. “Inclass” and “inschool” are constructed from information about frequency of skipping classes and missing school. The behaviour of skipping classes and missing school

indicate the student has made a decision to reduce investment in school-productive capital in the previous year. In the original survey, individuals are to indicate the frequency they skipped classes and missed school based on a four-category scale (1=never, 2=one or two times, 3=several times, 4=often). The variables "inclass" and "inschool" are constructed based on the reverse of this scale.

TABLE 4.1A
DEFINITIONS OF DEPENDENT VARIABLES

Variable	Definition
sjd	1 if self-reported delinquent activities were present in 1995 including activities such as participating in gang fights, using strong arms in fights, carrying weapons, beating up somebody without any reason, beating up somebody to force the person to do something, stealing more than \$100, stealing a bicycle, buying and using stolen goods, breaking and entering, and setting a fire, 0 otherwise.
vioc	1 if self-reported violent acts were present in 1995 including activities such as participating in gang fights, using strong arms in fights, carrying weapons, beating up somebody without any reason, beating up somebody to force the person to do something, 0 otherwise. (dependent variable in bivariate probit analysis)
proc	1 if self-reported property crimes were present in 1995 including activities such as stealing more than \$100, stealing a bicycle, buying and using stolen goods, breaking and entering, and setting a fire, 0 otherwise. (dependent variable in bivariate probit analysis)

TABLE 4.1B
DEFINITIONS OF EXPLANATORY VARIABLES

variable	definition (proxy for theoretical variable / relationship with dependent variable)
French	percentage score in French. (z_1 / -)
math	percentage score in math. (z_2 / -)
motivation	1 if the subject intended to pursue studies beyond high school completion. 0 otherwise (z_3 / -)
inclass	a 5-category scale variable with larger number indicating higher frequency of class attendance per school day. (z_4 / -)
inschool	a 5-category scale variable with larger number indicating higher frequency of school attendance per year. (z_5 / -)
workexp	1 if the subject had some work experience any time between the age of 14 and 16. (z_6 / -)
work	1 if the subject worked for a salary. 0 otherwise. (z_7 / -)
2parent	1 if subject was living with both biological parents. 0 otherwise. (z_8 or z_9 / -)
church	1 if subject had attended church services at least once during a year. 0 otherwise. (z_{10} or z_{11} / -)
friend	1 if the subject's best friend was arrested for delinquent activities. 0 otherwise. (z_{12} / +)
adult	1 if the subject knew adults who were arrested for criminal activities. 0 otherwise. (z_{13} / +)
bro/sis	1 if the subject's brother(s) and/or sister(s) was/were arrested for criminal activities. 0 otherwise. (z_{14} / +)
pmoney	a 10-category scale with higher values indicating larger amount of "pocket money" received per week from parents. (N / none)
urate	annual average unemployment rate for people over the age of 15 of the economic region an individual lives in. (w_1 / -)
policeexp	per capita police expenditure of the city an individual lives in. (m / -)
otherarea	1 if not living in the economic region of Montréal, Laval, Lanaudière, Les Laurentides, or Montérégie. 0 otherwise. (?)
Laval	1 if living in the economic region of Laval. 0 otherwise. (?)
Lanaudière	1 if living in the economic region of Lanaudière. 0 otherwise. (?)
Les Laurentides	1 if living in the economic region of Les Laurentides. 0 otherwise. (?)
Montérégie	1 if living in the economic region of Montérégie. 0 otherwise. (?)

Lagged values of market work, “workexp” and “work” are used to proxy the effect of work-productive capital generating institutions (z_t) on an individual’s time allocation decision. Work experience indicates work-productive capital accumulated through on-the-job training and work experience. As will be discussed in more details later, family influence from “2parent” and religious influence from “church” can either serve as proxies for school-productive capital generating institutions or work-productive capital generating institutions. The variable “2parent” is chosen in this case since each of the other categorization of family structures, such as adoptive parents and step parents, has relatively few observations and appears to be insignificant in affecting delinquency for the sample.³⁴ The variable “church” uses information from the survey question “do you go to church” which is based on a five-category scale (1=many times per week, 2=once a week, 3=once or twice per month, 4=special occasion, 5=never). Hence, “church” is coded as 1 if an individual’s answer to the original survey question was either 1, 2, 3 or 4, “church” is coded as 0 if the original answer was 0. “Church” is defined as attending church services at least once in the year since few individuals attend church services on a very regular basis such as at least once a week.³⁵

³⁴Alternatively, “family attachment” variables such as frequency of going out with family can be used, but have been shown to be insignificant.

³⁵Regression results from alternative definitions of “church” such as attending church services at least once a week have been shown to be insignificant.

“Friends,”³⁶ “adult,” and “bro/sis” are used to proxy crime-productive capital generating institutions on an individual’s time allocation decision. “Pmoney” indicates the amount of weekly pocket money received from parents on a ten-category scale coded as follows: 1=nothing, 2=less than\$2, 3=\$2 to \$5, 4=\$6 to \$10, 5=\$11 to \$20, 6=\$21 to \$30, 7=\$31 to \$40, 8=\$41 to \$50, 9=\$51 to \$100, 10=\$100 or more. “Pmoney” can be used as a proxy for non-labour income (N) from Chapter 3. Unemployment rate (“urate”) is used to represent the economic condition of the different regions. “Urate” can also be related and used as a proxy for the expected value of wages from market work (w_i). Lastly, a group of regional dummy variables are created to capture unexplained geographical differences.

Two sets of models are presented here: one set using cross-sectional data from 1995 when all subjects were 17 years of age, and the other set using longitudinal data from 1992 to 1995 when the subjects were between 14 and 17 years old. The choice of this time range is due to missing information on many variables in the year 1991.

The analysis will characterize the variables into three groups following the discussion of the theory in Chapter 3: school-productive institutions (z_s), work-productive institutions (z_w) and crime-productive institutions (z_c). The traditional economic literature has focused on the effects of schooling and work experience in the generation of human

³⁶The existence of delinquent best friend is use as a measure of “friend” in the analysis. An alternative measure is the number of delinquent friends. However, including both delinquent best friend and delinquent friends appear to lead to multicollinearity, resulting in decreases in significance of both factors.

capital (Becker, 1964). The Montréal Longitudinal Survey provides information on different aspects of schooling such as grades obtained in school, frequency of class and school attendance, and intention to pursue studies after high school. All these school-related features are used as proxies for school-productive institutions here and information on work experience is used as a proxy for work-productive institutions.

Other social institutions such as family, church, and peers were discussed in the economics of crime literature (for example, Phillips and Votey, 1987; Viscusi, 1986) as part of social capital accumulation process. Family and church are used as school-productive institutions here, and "friend," "adult," and "bro/sis" are used as crime-productive institutions.

Factors other than capital-generating institutional variables may also affect the level of delinquent behaviour. A larger amount of pocket money possessed, for example, may decrease the level of property crime if property crime and pocket money are considered alternative income-generating sources. A high unemployment rate implies difficulties in obtaining market work and lower expectation of earning a market wage (w_t), and therefore decreases the *opportunity cost* of committing property crime and more time spent on property crime (t_t). On the other hand, high unemployment rate may imply fewer *opportunities* of committing property crime.³⁷ Hence, there exist two opposing effects of unemployment rate on delinquency. From the theory presented in the last chapter, an

³⁷For example, unemployed individuals may be more likely to stay home to guard against their properties.

increased amount of police expenditure is assumed to have a direct positive effect on the probability of a crime being detected. Therefore, the cost of committing crime increases and the level of delinquency is expected to decrease with an increase in police resources.

Individual residential information is provided by postal codes. Individuals can therefore be identified by the cities/economic regions³⁸ (see Appendix 4B) in which they resided.³⁹ This kind of information can be used to detect unexplained regional characteristics that can cause either a higher or lower level of delinquent behaviour. This geographic information can also be used to match individuals with information on regional unemployment rates⁴⁰ and police enforcement expenditures.⁴¹ These two variables indicate the structural characteristics of the different areas in Quebec. For instance, unemployment rates show the general economic condition in the different regions. To use one example, Gaspésie-Îles-de-la-Madeleine had an exceptionally high unemployment rate over the years 1991 to 1995. Per capita police expenditures indicate the relative effort made to fight

³⁸The economic regions are defined according to the classification by Statistics Canada.

³⁹This was done by using the postal code check of the Canada Post's website (www.canadapost.ca). Postal code information of 1995 is not available unfortunately. The analysis therefore is based on postal code information from 1994, assuming that individuals had not moved between 1994 and 1995.

⁴⁰Information on annual unemployment rate of economic regions in Quebec are obtained from CANSIM (matrix 3487: D988487 to D988501 and D968839). Residential information from postal codes are then matched with data on unemployment rate of the respective economic region by using *Repertoire Des Municipalités Du Québec 2000* (section 3.3.4: region administrative, p.91-106) to obtain a measure of unemployment rate.

⁴¹The postal information is also used to match with data on per capita police expenditure published by Statistic Canada (Statistic Canada 85F00116XPB) to obtain a measure of police expenditure.

crime in different cities. Here the city of Montréal has the highest per capita expenditure on police activities in 1995. The postal information shows that about 70% of the individuals in our sample reside in the economic regions of Montréal, which is used as the base case for the empirical analysis. The rest of the sample is concentrated in Laval, Lanaudière, Les Laurentides, and Montérégie.

The analyses presented here eliminate all subjects who provide no information about their time spent on school, work, and the arrests of best friend, adult associates, brother(s) and/or sister(s). This practice at the same time serves to eliminate all individuals who fail to release information about their family structures, which will be included in later analyses. 658 observations are thus used in the cross-sectional model. Summary statistics of the variables are provided in Table 4.2.

TABLE 4.2
SUMMARY STATISTICS OF VARIABLES

Variables	Value of Dummy Variables	Cross section data (1995) ⁴²		Panel data (1992-1995)	
		Frequency	Mean	Frequency	Mean
sjd	0	367	0.44	1599	0.39
	1	291		1017	
vioc	0	425	0.35	only used in cross-section data analysis	
	1	233			
proc	0	476	0.28	only used in cross-section data analysis	
	1	182			

⁴²See Appendix 4A for the frequency distribution of categories for the 1995 cross-section data from the original survey questions.

French	scale variable	-----	62.55	only used in cross-section data analysis	
math	scale variable	-----	65.36	only used in cross-section data analysis	
motivation	0	189	0.71	781	0.7
	1	469		1795	
inclass	0	41	3.19	126	3.36
	1	12		38	
	2	69		187	
	3	197		663	
	4	339		1562	
inschool	0	41	2.88	only used in cross-section data analysis	
	1	49			
	2	117			
	3	194			
	4	257			
workexp	0	297	0.55	only used in cross-section data analysis	
	1	361			
hourwork	scale variable	only use in panel data analysis		-----	3.66
2parent	0	293	0.55	1122	0.56
	1	365		1454	
church	0	302	0.54	1064	0.59
	1	356		1512	
friend	0	434	0.34	1980	0.23
	1	224		596	
adult	0	394	0.4	1596	0.38
	1	264		980	
bro/sis	0	565	0.14	2227	0.14
	1	93		349	

pmoney	scale variable	-----	3.9	-----	792
Laval	0	634	0.04	only used in cross-section data analysis	
	1	24			
Lanaudière	0	598	0.09	only used in cross-section data analysis	
	1	60			
Les Laurentides	0	624	0.05	only used in cross-section data analysis	
	1	34			
Montréal	0	596	0.09	only used in cross-section data analysis	
	1	62			
otherarea	0	637	0.03	only used in cross-section data analysis	
	1	21			
urate	scale variable	-----	12.68	only used in cross-section data analysis	
policeexp	scale variable	-----	186.63	only used in cross-section data analysis	

Cross-sectional analysis

The purpose of the analysis is to examine the impact of various social institutions on the level of delinquency involvement. The social institutions chosen in this study include school, work, family, church, and various peer influences from friends, adult associates, brother(s) and/or sister(s). These social institutions can further be categorized into two main groups, namely those that mainly affect human capital accumulation, and others that are more likely to have impacts on social capital accumulation.

The analysis that follows will first consider only the effects of schooling and work experience on the level of delinquency that are part of the human capital argument in the traditional economic literature, and later include other influences from family, church,

peers, and regional characteristics for comparison purposes.

The Montréal Longitudinal Study possesses a rich set of variables related to schooling behaviour and decisions. While “grade” is a measure of school performance, “motivation” is a measure of expectations about school. “Inclass,” and “inschool” provide information on individual’s schooling decisions and attitudes towards school. In the analysis here, these variables represent school-related decisions made in the past and are used as proxies for school-productive institutions (z_j). The four school variables are likely to complement and correlated with each other. Appendix 4C provides the auxiliary R-square measures of each of the explanatory variables to as a check for the possibility of multicollinearity between the variables. Different combinations of the school variables are therefore used in various model specifications for comparison purposes and as a means of minimizing the effect of multicollinearity. The general model used for the cross section estimations that only include traditional economic variables can be written as follows:

$$(4.5) \quad BX = \beta_0 + \beta_1 (\text{school}) + \beta_2 (\text{workexp}) + \beta_3 (\text{money})$$

The dependent variable used in the logit analysis here is “sjd.” The estimation results for the coefficients of the variables with their corresponding t-statistics in parenthesis are summarized in Table 4.3A, and the marginal effects of the variables summarized in Table 4.3B.

School

The results from Tables 4.3A and 4.3B show that all the school variables have the expected relationship with delinquency as predicted by the theory, except for “math.” “French” is found to have a significant negative relationship with delinquency across different model specifications, but there is no significant relationship between “math” and delinquency. For example, one percentage point increase in the grade of French decreases the probability of committing delinquency by about 0.2% according to model (1) of Table 4.3B. This implies that better performance in language skill has some impact in controlling the level of delinquency. However, better mathematics skill appears to have mixed effect⁴³ or no significant impact on delinquency. School performance has a negative impact on the probability of delinquency involvement. The coefficient of “motivation” is found to have a significant negative relationship with the probability of delinquent involvement across different model specifications, implying that individuals who have plans for study beyond high school are less delinquent. According to model (1) of Table 4.3B, the probability of committing delinquency decreases by about 9% if an adolescent is motivated to pursue studies beyond high school completion. Notice that the coefficients of “French” (model 2) and “motivation” (model 3) significantly increase when other school variables are absent from the analysis, suggesting the possibility of multicollinearity between the various school variables.

⁴³I speculate that the study of mathematics encourages logical and rational thinking, which can be part of crime-productive capital. On the other hand, higher grade in mathematics, and better performance in any subject in school in that sense, encourages an adolescent to invest further in schooling and their stock of school productive capital, and therefore shy away from delinquency. Good performance in mathematics therefore has two opposing forces in affecting the level of delinquency.

TABLE 4.3A
RELATIONSHIP OF TRADITIONAL ECONOMIC VARIABLES TO
DELINQUENCY: COEFFICIENTS OF VARIABLES

Variables	(1)	(2)	(3)	(4)	(5)
French	-0.0091* (-1.32)	-0.0221*** (-3.46)	-----	-----	-----
math	0.0053 (0.86)	-0.0017 (-0.29)	-----	-----	-----
motivation	-0.3786** (-1.80)	-----	-0.8614*** (-4.81)	-----	-----
inclass	-0.3093*** (-2.60)	-----	-----	-0.5752*** (-6.93)	-----
inschool	-0.2573*** (-2.58)	-----	-----	-----	-0.5135*** (-7.05)
workexp	0.5274*** (3.05)	0.600*** (3.58)	0.5183*** (3.16)	0.4855*** (2.89)	0.5000*** (2.98)
pmoney	0.0938** (2.12)	0.0945** (2.20)	0.0946** (2.24)	0.0903** (2.08)	0.0847** (1.96)
Value of log-likelihood function	-409.84	-426.72	-434.17	-417.76	-418.63
McFadden R ²	0.0926	0.0553	0.0388	0.0751	0.0732
Count R ²	0.567	0.543	0.5326	0.5559	0.4967
LR statistics	83.7	49.94	35.04	67.86	66.13
Observations	658	658	658	658	658

*Significant at 10% level (1-tailed test)

**Significant at 5% level (1-tailed test)

***Significant at 1% level (1-tailed test)

School attendance from the previous year is assumed to be part of the human capital accumulation process through school, and therefore is expected to decrease the probability of being delinquent. Results from Tables 4.3A and 4.3B show that “inclass” and “inschool” both have significant negative relationships with the probability of delinquency involvement. For instance, model (1) of Table 4.3B shows that a unit increase

in “inclass” and “inschool” lead to a decrease in the probability of being delinquent by about 8% and 6% respectively. Multicollinearity is also detected between the two attendance variables. The coefficients of these variables were found to increase in significance once the other school variables are removed from the estimation.

Market work

Previous market work experience is the most obvious form of work-productive institution especially if the job can provide useful skills. The theoretical model presented in the last chapter suggests that the relationship between work-productive institution and delinquency involvement is negative. Teenagers, however, are notoriously concentrated in low paid and menial work due to their lack of skills and credentials. Low paid menial work therefore may not be a good indicator of work-productive institution. The economics of crime literature has also found mixed evidence on the relationship between work and delinquency (Good and Pirog-Good, 1987; Light, 1998; Ruhm, 1995 and 1997).

Results from Tables 4.3A and 4.3B indicate a significant positive relationship between market work and the level of delinquency. For example, the presence of work experience between the age of 14 and 16 increases the probability of being delinquent by about 11% according to the findings. An individual has a higher probability of being delinquent as he accumulates more market work experience. These findings imply that adolescents who have accumulated much market work experience at an early age may have devoted less effort to school, which perhaps may be the more important channel in the process of human capital accumulation.

TABLE 4.3B
RELATIONSHIP OF TRADITIONAL ECONOMIC VARIABLES TO
DELINQUENCY: MARGINAL EFFECTS OF VARIABLES

Variables	(1)	(2)	(3)	(4)	(5)
French	-0.0022*	-0.0055***	-----	-----	-----
math	-0.0013	-0.0004	-----	-----	-----
motivation	-0.0934**	-----	-0.2123***	-----	-----
inclass	-0.0763***	-----	-----	-0.1481***	-----
inschool	-0.0635***	-----	-----	-----	-0.1265***
workexp	0.1301***	0.1481***	0.1277***	0.1197***	0.1232***
pmoney	0.0231**	0.0233**	0.0689**	0.0223**	0.0209**
Observations	658	658	658	658	658

*Significant at 10% level (1-tailed test)

**Significant at 5% level (1-tailed test)

***Significant at 1% level (1-tailed test)

The analysis so far has only included variables that are discussed in the traditional economics literature. The next task is to include other influences on delinquency. Only “inlcass” and “motivation” are used to represent the school variables in order to minimize the effect of multicollinearity. The estimation results of the extended model are provided in Table 4.4.

Family

The physical absence of adults in a family is described as a “structural deficiency” in family social capital (Coleman, 1988). Children from two-parent families are thus supposed to be in a better position to accumulate human and social capital. The analysis here considers family as a school-productive capital generating institution (z_i) since responsible parents usually care about how their children do in school. Estimation results

from Table 4.4 show that the probability of being delinquent decreases by about 8% for adolescents who lived with both biological parents and these results are statistically significant at the 5% level. These findings confirm the general belief that a stable family is more likely to provide better support for the children and to discourage them from turning into delinquents. The effects of having step-parents on delinquency, unfortunately, cannot be examined by the current data set since there are too few subjects who lived with step parents at the age of 17 in 1995.

TABLE 4.4
RELATIONSHIP OF DIFFERENT FORMS OF INSTITUTIONS TO DELINQUENCY

Variables	model (1)		model (2)	
	coefficient	marginal effect	coefficient	marginal effect
motivation	-0.3209* (-1.51)	-0.0790*	-0.3301* (-1.55)	-0.0812*
inclass	-0.3657*** (-3.88)	-0.0900***	-0.3616*** (-3.86)	-0.0890***
workexp	0.4177*** (2.26)	0.1028***	0.4152*** (2.25)	0.1022***
pmoney	0.0821** (1.73)	0.0202**	0.0846** (1.78)	0.0208**
2parent	-0.3202** (-1.73)	-0.0788**	-0.3060** (-1.67)	-0.0953**
church	-0.2006 (-1.07)	-0.0494	-0.1996 (-1.07)	-0.0491
friend	0.8761*** (4.36)	0.2156***	0.8872*** (4.42)	0.2183***
adult	1.0689*** (5.63)	0.2631***	1.0667*** (5.64)	0.2645***
bro/sis	0.2113 (0.80)	0.052	0.2000 (0.76)	0.0492

Laval	0.3371 (0.51)	0.0830	-----	-----
Lanaudière	0.1007 (0.17)	0.0248	-----	-----
Les Laurentides	-0.0971 (-0.15)	-0.0239	-----	-----
Montréal	0.1028 (0.18)	0.0253	-----	-----
Other areas	-0.1012 (-0.17)	-0.0250	-----	-----
Urban	-----	-----	-0.0829 (-0.94)	-0.0204
Police/exp	-----	-----	0.0011 (0.36)	0.0003
Value of log-likelihood function	-369.99		-369.85	
McFadden R ²	0.1809		0.1809	
Count R ²	0.6202		0.6201	
LR statistics	163.4		163.69	
Observations	658		658	

*Significant at 10% level (1-tailed test)

**Significant at 5% level (1-tailed test)

***Significant at 1% level (1-tailed test)

Church and Religiosity

Religious activities that lead to a better after-life and “religious satisfaction” can be regarded as part of the human capital accumulation process (Iannaccone, 1990 and 1998). Religious participation can also extend an individual’s social network, which is important for the formation of social capital (Ellison, 1995). Church is therefore assumed to help an individual to lead a responsible life in various aspects. It is assumed here that “church” is a form of school-productive institution since one of the primary responsibilities of young

people is to behave and perform in school according to most societies. The religious population is predominantly Catholic in Montréal, and hence the possible different effects of various religions on moderating juvenile crime cannot be examined since the population is not heterogenous enough in terms of religion to allow for such analysis.

The analysis presented here therefore focuses on the church attendance as a measure of religiosity. The variable “church” is found to have an insignificant negative relationship with the probability of delinquent involvement, implying that religion may have only limited impact on moderating delinquency.⁴⁴

Peers

The Montréal Longitudinal Study contains information on different types of peer influences. The subjects were asked whether they knew of police arrests of their best friends, adult associates, brother(s) and/or sister(s) in a previous time period. The theoretical model presented in the last chapter suggests that association with other criminals and/or delinquents can help an individual better to develop his own criminal skills (crime-productive capital generating institutions, z_i) and therefore increase an individual's own delinquent involvement.

Estimation results from Table 4.4 confirm the theoretical suggestions. Delinquency of an adolescent's best friend is shown to significantly increase the probability of the adolescent's own delinquency by about 22%. An adolescent who knew of other adult

⁴⁴Church attendance is found to have a statistically significant negative relationship with alcohol and drug consumption. The influence of church and religion appears to have stronger impacts on certain forms of delinquency than others.

criminals is also shown to be about 26% more likely to be a delinquent himself. The delinquency of brother(s) and/or sister(s), however, appears not to have a significant influence on an adolescent's delinquency choice.

The analysis in general has shown the significant effects of hanging around a "bad crowd" on delinquency. The more an adolescent comes into contact with other delinquents and adult criminals, the more likely that the teenage would be a delinquent himself. Whether the delinquency of others causes one's own delinquency is difficult to detect. Often time there exists a self-selection problem where delinquents tend to flock together and in each other's company. The analysis here uses "friend" from a previous time period to proxy for crime-productive institution (z_i). Among the many variables included in the analysis, nevertheless, the delinquency of an adolescent's best friend appears to have the most influence on the adolescent's own delinquent involvement.

Pocket Money

Pocket money is considered a form of non-labour income (N). According to the theory presented in the last chapter, non-labour income does not affect the decisions on time uses.⁴⁵ The results from Tables 4.3A and 4.3B show that the amount of pocket money is positively related to the level of delinquent involvement. This positive relationship is shown to be statistically significant at the 5% level. Estimates from Table 4.4 further confirm this result. One possible interpretation of this result is that "pmoney" is

⁴⁵This is driven by the fact that non-labour income (N) is assumed not to be dependent on any form of time uses (t) or social institutions (z) in the theory. N therefore does not appear in the first order conditions and comparative statics performed on N is zero

an indicator of parental monitoring effort. Parents who work long hours, especially single parents, are likely to provide a larger amount of pocket money to their children, for example, money to purchase meals. At the same time, these children are less monitored by their parents and are more likely to be freely engage in delinquency.

Regional Characteristics

Delinquent behaviour may sometimes be affected by the region or area of an individual's residence, representing regional differences that cannot be explained by other factors included in the analysis. Regional dummy variables are created to represent the economic regions of Montréal, Laval, Lanaudière, Les Laurentides, and Monterégie. The estimation results from Table 4.4 show that all the coefficients and the marginal effects of the regional dummies are insignificant. This implies that there is no significant unexplained regional differences that affect the level of individual delinquent behaviour

Structural Variables

Two structural variables, unemployment rate ("urate") and police expenditure ("policeexp"), are formulated to capture regional characteristics. The estimation results from Table 4.4 show that neither of these variables have a significant relationship with the probability of being a delinquent. This may imply that the effect of unemployment rate to decrease the opportunity cost of delinquent activities may be canceled out by the fewer opportunities in committing delinquency. Another possible explanation for the insignificant result is the lack of geographic variation since 70% of the sample resided in the Montréal

area.

Overall goodness of fit

The goodness of fit of the models can be examined using different R-square measures. The analysis here presents the McFadden R-squares and Count R-squares for each model. The McFadden R-squares for models that include only the school and market variables are found to be around 10% when all the school variables are included as reported in model 1 of Table 3A. The McFadden R-square measures increase to 18% when other capital variables such as “2parent,” “church,” various peers measures and regional characteristics are added to the analysis as reported in Table 4. 4. As a general rule of thumb, a higher R-square measure indicates better goodness of fit. A low R-square measure, however, is common in research using individual data, such as the present study. For example, the R-square values reported by Phillips and Votey (1987b) in their studies were as low as 0.00.

A more intuitive R-square measure for discrete choice models is the count R-square measure. The count R-square is calculated by using the proportion of correct predictions. Count R-square measures generated from models that include only school and market work variables were found to be around 55% (as reported in Table 4.3A) while the count R-square for the model with the more extensive set of variables is found to be 0.62 (as reported in Table 4.4).

The likelihood ratio tests for all versions of the model from Table 4.3A and Table 4.4 give significant results. Such findings imply that the null hypothesis that all slope

coefficients are equal to zero can be rejected.⁴⁶ However, the likelihood ratio tests increase in significance when the social capital and regional variables are added to the analysis. Judging from the different measures, the model can be considered to have a reasonable overall goodness of fit by comparing to estimation results generated from earlier literature.

Panel analysis

The Montréal Longitudinal Study provides an informative data set which follows the same individuals for a number of years. The discussion so far only makes use of the cross-sectional features, and does not yet exploit the longitudinal characteristics of the data. The goal of this section is to examine the panel features of the data.

Stable individual traits such as inborn criminality or early childhood trauma that can be indicated by any kind of abuses experienced at a very young age are considered by some researchers to be the most important causes of delinquency (Gottfredson and Hirschi, 1990). Such individual characteristics are unobservable and relatively stable over time. Such debate is highlighted by the media coverage of the Colorado high school shooting in 1999, for example. In this particular event, one of the shooters, Eric Harris, is portrayed as the “leader” and the “bad seed” while his shooting partner, Dylan Klebold, is considered the follower who had chosen the wrong leader (Gibbs, 1999). The panel data analysis aims to distinguish the differences between the effects of individual differences and social influences on delinquent behaviour.

⁴⁶Different F-tests, not surprisingly, show that the human capital variables (the school and work variables) are jointly significant, and so are the social capital variables (“2parent,” “church,” and the various peer variables). The regional and structural variables, on the other hand, are not jointly significant.

Individual differences that arise from stable individual traits or early negative experiences can be captured by the fixed effects model. The following analysis will incorporate the individual fixed effects in a panel data model. The goal is to examine the effects of capital-generating institutional variables on delinquency with the presence of individual fixed effects. The individual-specific fixed effect⁴⁷ can be found by creating vectors of dummy variables to represent each individual so that each of them has a different intercept term.

There exist various social forces that can influence individuals' decision on delinquency participation. From earlier analysis, it has been shown that participation in school-related activities, presence of biological parents, and the presence of delinquent peers are all important factors in affecting delinquency choice. These factors are referred to as capital-generating institutional variables in earlier analysis.

The time period chosen for the panel data analysis is 1992 to 1995 when the boys were between 14 to 17 years old since the 1991 survey contains much less information for some unknown reasons. Individual differences due to life experiences before the age of 14 will be captured by the individual fixed effects. After eliminating all those who failed to respond to the questions that are used to formulate the variables, 644 individuals remain in the sample. The summary statistics of the variables are provided in Table 4.2. Note that "frequency" of the panel data in Table 4.2 is tabulated as the "cumulative frequency," which means counting each of the 644 individuals in each of the four years from 1992 to

⁴⁷The present study makes use of the fixed effects analysis to capture individual differences. Other economic studies on crime have also discussed the applications of the fixed effects analysis in different settings (Trumbull, 1989; Doyle, Ahmed and Horn, 1999).

1995 as different entries, thus giving a total of 2576 counts.

Two sets of estimation results will be presented in this section using “sjd” as the dependent variable, a first set that does not include the individual fixed effects, and a second that will include the individual-specific fixed effects. The first specification is used as the benchmark case for comparison purposes. The regression equation for the benchmark case using the panel data can be written as follows.

$$(4.7) \quad BX = \beta_0 + \beta_1 (\text{motivation}) + \beta_2 (\text{inclass}) + \beta_3 (\text{work}) + \beta_4 (\text{pmoney}) \\ + \beta_5 (2\text{parent}) + \beta_6 (\text{church}) + \beta_7 (\text{adult}) + \beta_8 (\text{friend}) + \beta_9 (\text{bro/sis})$$

“Workexp” from the cross section analysis is being replaced by “work” in the panel data analysis. Such replacement is exercised because “workexp” is constant by definition, while “work” changes on an annual basis. Regional characteristics such as unemployment rate and police expenditure cannot be used in the panel data analysis due to the lack of residential information for earlier years from the database. The definition of BX is modified in the model that takes into account the individual-specific fixed effects and can be written as follows,

$$(4.8) \quad BX = \sum \alpha_i D_{it} + \sum \beta_m z_{mit} + \varepsilon_{it}$$

where D_{it} represents the dummy variables created for each individual i at each of t time periods, z_{mit} represents the vector of m individual variables at each of t time periods and for

each individual, and ε_{it} is the error term. D_{it} will thus be recorded as one for individual i in different years whereas α_i captures differences in stable individual traits such as criminal propensity, which is a proxy for Ω in Chapter 3. The coefficients of the variables with their respective t-statistics in parentheses are reported in Table 4.5⁴⁸.

(1) Individual-specific effects

The parameter α_i from equation (4.8) captures differences in stable individual traits such as criminal propensity. The Hausman specification test can be applied to examine the significance of the individual fixed effects by comparing the model with the fixed effects to the model without the fixed effects. The Hausman test statistic (H) can be specified as follows:

$$(4.9) \quad H = (b_{\text{fix}} - b_{\text{nofix}})' [V_{\text{fix}} - V_{\text{nofix}}]^{-1} (b_{\text{fix}} - b_{\text{nofix}}),$$

where the b 's represent the coefficient matrices and the V 's represent the covariance matrices. The null hypothesis of the Hausman test is that the model without the fixed effects is the correct specification, that is, H_0 : no fixed effects. The Hausman test in this study generates a Chi square statistic = 13.11 with 9 degrees of freedom. The implication is therefore that the null hypothesis that the individual fixed effects are insignificant cannot

⁴⁸The panel analysis follows the method proposed by Chamberlain (1980), where α_i , or the coefficients of the fixed effects, cannot be estimated since the number of parameters increases with the number of observations. It is therefore not possible to compute the marginal effects for this model, because the probabilities cannot be computed without the fixed effects. For a more detailed discussion on this issue, see Greene (2000).

be rejected. Stable individual traits can at best have very limited impact on delinquent behaviour.

TABLE 4.5
RELATIONSHIP BETWEEN INSTITUTIONAL VARIABLES AND DELINQUENCY
PANEL DATA ANALYSIS

Variables	Model without fixed effects	Model with fixed effects
motivation	-0.2439** (-2.08)	-0.1667 (-1.03)
inclass	-0.2615*** (-3.95)	-0.2825*** (-3.06)
work	0.1306 (1.19)	0.1095 (0.76)
pmoney	0.0954*** (3.49)	0.1091*** (2.95)
2parent	-0.3421*** (-3.32)	-0.4044*** (-2.96)
church	-0.0486 (-0.46)	-0.3299** (-2.31)
friend	1.0849*** (8.33)	1.3659*** (7.08)
adult	0.7624*** (6.90)	0.7941*** (5.25)
bro/sis	0.2189 (1.42)	0.2560 (1.26)
Value of log-likelihood function	-1146.05	-378.12
observations	644	644

***significant at the 1% level (1-tailed test)

**significant at the 5% level (1-tailed test)

*significant at the 10% level (1-tailed test)

Since the study consists only of periods when the boys were between 14 and 17 years old, whether there exists absolutely no difference in inborn criminality between individuals cannot be easily determined. Some researchers may want to examine

coefficients of the individual dummies. A higher t-statistic on the coefficient of an individual dummy can be an indication that the individual represented by that dummy has an underlying inborn tendency to be a delinquent. Such interpretation should be taken with caution due to the short period of time covered. The analysis here therefore will not emphasize on the examination of the significance of each dummy, but will focus on the extent to which the individual fixed effects influence the capital variables. Another possible explanation is the homogeneity of the population examined. Since the sample population is homogenous by survey design as pointed out earlier, it will not be surprising that the test on individual differences gives a marginally significant result.

One way to examine the impact of the individual fixed effects on the capital-generating institutional variables is through the application of the Wald Chi square test. The exercise can be carried out by comparing the coefficients of the institutional variables between equations excluding and including the individual fixed effects. This can be done by performing Wald-tests on the various variables. The coefficients of the capital-generating institutional variables from the model with the fixed effects are used as the null hypotheses. The coefficients of the corresponding variables from the model that does not include the fixed effects are then used to test against the null hypotheses. The following null hypotheses are thus formulated using the coefficients from the model with the fixed effects,

$$\beta_{\text{motivation}} = -0.1667, \beta_{\text{inclass}} = -0.2825, \beta_{\text{work}} = 0.1095, \beta_{\text{pmoney}} = 0.1091,$$

$$\beta_{2\text{parent}} = -0.4044, \beta_{\text{church}} = -0.3299, \beta_{\text{fricnd}} = 1.3659, \beta_{\text{adult}} = 0.7941, \text{ and}$$

$$\beta_{\text{bro/sis}} = 0.2560.$$

The Wald Chi square statistics are shown in Table 4.6.

TABLE 4.6
WALD CHI-SQUARE STATISTICS FOR THE INSTITUTIONAL VARIABLES IN
THE MODEL WITHOUT INDIVIDUAL-SPECIFIC EFFECTS

Capital Variables	
motivation	0.4336
inclass	0.1008
work	0.3745
pmoney	0.2578
2parent	0.3668
church	6.9775***
friend	4.6556***
adult	0.0821
bro/sis	0.0582

***significant at the 1% level

As shown in Table 4.6, the Wald Chi-square statistics are insignificant for all variables, except for "church" and "friend." This implies that the coefficients of most of the variables from the model with the fixed effects cannot be considered significantly different from those for the model without the fixed effects. However, significant differences are found for "church" and "friend." These results imply that individual fixed effects may still be important in that they may alter the effect of "church" and "friend" on delinquency. In fact, "church" is shown to be an important determinant of delinquency under the fixed effects model. This evidence on the significance of church influence is also different from the implications of the cross-section analysis.

(2) Institutional variables

Estimation results from Table 4.5 show that the school variable “inclass” has a significant relationship with the level of delinquency, but “motivation” has an insignificant coefficient once the fixed effects are taken into account. Both “inclass” and “motivation” are constructed using observations from a previous year. Adolescents who attended classes on a more frequent basis over the years were found to be significantly less delinquent than those who attended school less often. School therefore appears to be an important social institution in controlling delinquency.

Another social institution that is considered important by some researchers in the human capital accumulation process is the workplace. The panel data study in Table 4.5, however, shows that work has no significant relationship with the level of delinquency. As discussed earlier, although work experience may be an asset for future job prospects, more hours spent on working may also imply less effort devoted to school, which may be the more important channel in human capital accumulation, especially for younger adolescents. The two opposing effects may both be at work, leading to the insignificant relationship between “work” and the level of delinquency.

Family structure remains to have a significant relationship with the level of delinquency. Adolescents who were living with both biological parents were found to be significantly less delinquent than those who did not. Church attendance has a significant negative relationship with delinquency once the fixed effects are taken into account in the panel data analysis. Compare to the insignificance of “church” in the cross section analysis presented earlier, this may imply that church is a more important channel in controlling delinquent behaviour of younger adolescents since the sample for the panel data analysis

contains the same individuals at a younger age as in the cross-sectional analysis.

Delinquent and criminal associates are shown to have significant influences on delinquent behaviour in the panel data analysis. The delinquency of the individual's best friend significantly increases the probability of an individual's own delinquency. An adolescent who knew of criminal adults are also found to be significantly more delinquent than those who did not. The delinquency of brother(s) and/or sister(s) also shows a positive relationship, though statistically insignificant, with one's own delinquency. The amount of "pocket money" is found to have a significant positive relationship with self-reported delinquency in the panel data analysis.

Findings from the panel data can be considered largely consistent with those from the cross-sectional analysis presented earlier. The main advantage of the cross-section analysis is that it allows the examination of structural characteristics such as unemployment rate and police expenditure. The cross-section analysis also contains 14 more observations than the panel data analysis. The advantage of the panel data analysis, on the other hand, is to allow the examination of individual fixed effects. It also provides some further implications of how certain factors may have more important impacts on delinquency at a younger (older) age. For example, while church is found to have no significant relationship in the cross section analysis, it is found to have a significant negative coefficients in the panel data analysis with the fixed effect model. Next we will examine the differences between violent acts and property crimes.

Violent offences versus property crimes

The analysis so far aggregates ten types of self-reported delinquent behaviour to

generate the dependent variable. These ten types of delinquent acts can be segregated into two major categories, namely violent behaviour and property crimes. Since property crimes are motivated by financial gains while violent crimes are more often "crimes of passion" (Hellman, 1980) and are affected by emotions, an economic model of criminal behaviour may be expected to explain property crimes better. Although earlier analyses show that most social institutions have influences on delinquent behaviour in general, these institutions may have different effects on violent behaviour and property crimes. The goal of this section is to examine the potential differences of the various institutions in affecting the two categories of delinquent behaviour.

The analysis here assumes an individual's choice to commit property and violent crimes as a joint decision-making process since this decision can be viewed as a time allocation decision within the fixed amount of time allocated to spend on delinquent activities (t_i) in general. The empirical model chosen to estimate the joint decision model is the bivariate probit model since each of the two equations has a 0-1 dummy dependent variable. The estimation results are provided in Table 4.7.

The results from Table 4.7 show that while the behaviour of skipping classes has a significant positive relationship with both violent acts and property crimes, attitude towards school as reflected by "motivation" has a significant positive relationship only with violent acts, but not property crimes. It is further shown by the marginal effects that both the probability of committing violent acts and property crime decrease by about 7% for each unit increase of "inclass." The probability of committing violent acts decreases by about 8% for an adolescent who intends to pursue study beyond high school. Lack of aspiration on school may be an indication of the lack of self-control when an individual's

TABLE 4.7
EFFECTS OF VARIOUS FACTORS ON VIOLENT ACTS
AND PROPERTY CRIMES: A BIVARIATE PROBIT ANALYSIS

Variables	Violent acts		Property crimes	
	coefficient	marginal effect	coefficient	marginal effect
motivation	-0.1935* (-1.51)	-0.0838*	-0.0614 (-0.47)	-0.0272
inclass	-0.1657*** (-3.14)	-0.0718***	-0.1789*** (-3.39)	-0.0786***
workexp	0.2640*** (2.36)	0.1145***	0.1509* (1.29)	0.0662*
pmoney	0.0260 (0.98)	0.0113	0.0578** (2.04)	0.0254**
2parent	-0.0191 (-0.17)	-0.0081	-0.1993** (-1.68)	-0.0874**
church	-0.1391 (-1.25)	-0.0604	-0.0869 (-0.74)	-0.0381
friend	0.4867*** (3.88)	0.2111***	0.4283*** (3.28)	0.1880***
adult	0.5095*** (4.32)	0.2203***	0.5683*** (4.68)	0.2491***
bro/sis	0.0733 (0.44)	0.0317	0.2771** (1.82)	0.1215**
urate	-0.0025 (-0.05)	-0.0012	-0.0931 (-1.24)	-0.0413
policeexp	0.0001 (0.01)	0.0001	0.0021 (0.85)	0.001
correlation coefficient	0.5180*** (8.85)			
Value of log-likelihood function	-555.01			
observations	658			

***significant at the 1% level (1-tailed test)

**significant at the 5% level (1-tailed test)

*significant at the 10% level (1-tailed test)

decisions are made impulsively rather than rationally. While violent acts are likely to be motivated by impulses and emotions, property crimes generally require more planning and calculation. Thus it may not be surprising that individuals who lack self-control are likely to be less motivated to study, and be more likely to commit violent offences rather than property crimes.

The accumulation of early market work experience appears to significantly increase the probability of committing violent acts and property crimes by about 11% and 6% respectively. This kind of finding may be contrary to some other findings. Market work may allow youth to easily “explain” the possession of property that are in fact stolen goods. Also, opportunities to commit property crimes are sometimes thought to increase when an individual becomes involved in market work and has access to other people’s property.

The probability of committing property crime decreases by about 8% if an adolescent lives with both biological parents. Adolescents who lived with both biological parents were found to be less delinquent in both violent acts and property crimes, but this negative relationship is only significant in the case of property crimes. This may be an indication of a significant relationship between family income and juvenile delinquency in the form of property crimes. Perhaps a two-parent household is more financially able to provide their children with what they want and therefore more likely to decrease the probability of their children committing property crimes⁴⁹.

⁴⁹The relationship between two parent household and property crimes committed by children are complicated. When the variable “2parent” (living with both biological parents) is replaced by a variable that indicates living with two but not necessarily

Although a negative relationship is detected between church attendance and delinquency, the relationship is statistically insignificant in both the cases of violent acts and property crimes. This is consistent with the results from the cross section analysis presented earlier in this chapter. This implies that religion may have limited effect on both property crime and violent acts for older adolescents.⁵⁰

Associations with delinquent friends, adults, brother(s) and/or sister(s) continues to have significant positive relationships with an individual's own delinquency in the bivariate probit analysis, except for the effect of "bro/sis" on violent acts. For example, the presence of delinquent brother(s) and/or sister(s) is found to be statistically insignificant in the case of violent crimes, but significant at the 5% level in the case of property crimes. This is a possible indication that group delinquencies generally involve more planning, which is more a characteristic of property crimes rather than violent acts. As mentioned earlier, violent acts are more likely to be committed by impulse, implying that these are acts more likely to be unplanned and committed by one person rather than groups of individuals. The presence of a delinquent best friend and criminal adult(s) in general increases the probability of committing violent acts and property crimes by about 19% to 25%. These

biological parents, the relationship decreases in significance. This implies that, although total family income may have an impact on children's property crime behaviour, biological parents may have some influences in controlling property crimes that cannot be explained simply by financial support.

⁵⁰ Although church attendance may not have any influence on 17-years old, it was shown earlier in the panel data analysis that church attendance has a significant impact on younger adolescents.

results indicate that hanging around a bad crowd is exceptionally important in the determination of the level of delinquent behaviour.

A larger amount of pocket money is shown to increase significantly the probability of property crime, but has no significant effect on violent acts. Larger amount of pocket money received is sometimes thought to be able to decrease the level of property crimes because earnings from property crimes will then be required less as an alternative income source. This view, however, cannot be supported by the results from the bivariate probit analysis. It may be easier for children to “explain” the possession of stolen property if they receive a larger amount of pocket money from their parents. However, violent acts are more impulsive behaviour and may not be influenced by parental monitoring as much as property crimes.

Another interesting finding from the bivariate probit analysis is that the correlation coefficient of the two phenomena is significantly positive. This implies that adolescents who self-reported their violent acts are also more likely to self-report their property crimes. Perhaps it is not surprising that an individual acts out in different ways once he decides to be “delinquent.” Estimations using bivariate probit analysis shows that the extent to which different social institutions affect violent acts and property crimes tends to vary. This implies that the economic model presented in the last chapter does not necessarily explain property crimes better than violent behaviour or vice versa. Different aspects of school may have different impacts on the two types of delinquency. A positive relationship is detected between work experience and the two different types of crime. The presence of

both biological parents appears to be more effective in controlling property crimes than violent acts. Delinquent peers also appear to have an even stronger impact on both property crimes and violent acts.

4.2 Concluding Remarks

The goal of this chapter is to examine the relationship between different capital-generating institutional variables and self-reported juvenile delinquent behavior. Three sets of estimations are performed for this purpose. The analysis began with the examination of cross-section data from 1995, then proceeded to panel data analysis with the discussion of individual fixed effects. The last set of regressions distinguishes between violent offences and property crimes and examines the potential influences of various social institutions on these two different types of delinquency.

The major categories of explanatory variables employed in this paper are (1) school variables, (2) work variables, (3) family variables, (4) church variables, and (5) delinquent peers variables. The models are found to have reasonable goodness of fit. Although coefficients of some individual variables are found to be insignificant, the signs of the independent variables are mostly consistent with the theoretical suggestions. Social institutions such as school, family, and peers are shown to play important roles in deterring delinquency. Individual measures within each institution, however, seem to differ in their significance.

In examining the importance of school in generating human (and social) capital, a

significant negative relationship is found between grades and probability of delinquency involvement in both the cross-section and panel data analysis. Further examination using the bivariate probit analysis shows that intention to pursue study beyond high school have a significant negative relationship with violent offences, but no significant relationship is detected with property crimes. This implies that certain institutional factors can have different impacts on violent acts and property crimes. The behaviour of skipping classes was found to have a significant positive relationship with delinquency in all cross-section, panel, and bivariate probit analyses. In the early cross-section analysis, it was shown that intention to pursue studies beyond high school can also serve to control delinquency, while the behaviour of missing school days can increase the probability of delinquency involvement.

Presence in the job market appears to have a positive relationship with delinquency involvement. The bivariate probit analysis further shows that a working adolescent is more likely to commit both property crimes and violent acts. This is consistent with findings from previous literature that teenagers may use work as a cover-up of their delinquent behaviour (Good and Pirog-Good, 1987).

Family influences on delinquency are measured by family structure in this study. The estimation results from both the cross-sectional and panel analyses show that adolescents who lived with both biological parents were less delinquent than those who did not. The bivariate probit analysis, on the other hand, shows that the presence of both parents may have a stronger impact on controlling property crime, but no significant impact

on violent behaviour.

Certain people and organizations believe that religion should have positive effects on inducing moral compliance of youths (Phillips and Votey, 1987b). The results obtained here, however, lend only minimal support to such beliefs. The negative relationship between church attendance and self-reported delinquent behaviour was found to be insignificant from the original cross-section analysis and the bivariate probit analysis. Such negative relationship, however, was found to be significant at the 5% level from the panel analysis, implying that church may have a stronger influence on younger adolescents.

Hanging around a bad crowd or association with delinquent peers were found to have important consequences on delinquency choice. Throughout the analysis, the presence of a delinquent best friend and association with criminal adult(s) were found to significantly increase the probability of one's own delinquency involvement. From the estimation results of the multivariate probit analysis, it was further shown that there exists a significant positive relationship between the probability of committing property crimes and the presence of delinquent brother(s) and/or sister(s).

The panel data estimation is generated using a fixed effects model. The result from the Hausman test showed that the individual fixed effects are marginally significant. These individual specific fixed effects partly represent stable individual traits such as inborn criminality. The results therefore imply that, while social influences have vital impacts on controlling delinquency, stable individual traits may also play a role in the determination of individual delinquent involvement.

APPENDIX 4A
ORIGINAL SURVEY QUESTIONS AND FREQUENCY DISTRIBUTION OF
VARIABLES

variable name	original survey question in French (frequency distribution in parentheses)
French	Au cours de cette année scolaire, quelle est ta note moyenne en français?
math	Au cours de cette année scolaire, quelle est ta note moyenne en mathématiques?
motivation	Si cela ne dépendait que de toi, jusqu'ou' aimerais-tu continuer d'aller à l'école plus tard? 1 je ne veux pas terminer le secondaire (14) 2 je veux terminer le secondaire (116) 3 je veux terminer le CEGEP (243) 4 je veux terminer l'université (226) 5 cela ne me fait rien, cela ne me dérange pas (59)
inclass	Au cours de cette année scolaire, as-tu manqué un cours pendant que tu étais à l'école? 0 quittez l'école (41) 1 jamais (339) 2 une ou deux fois (197) 3 plusieurs fois (69) 4 très souvent (12)
inschool	Au cours de cette année scolaire, as-tu manqué l'école sans une excuse valable? 0 quittez l'école (41) 1 jamais (257) 2 une ou deux fois (194) 3 plusieurs fois (117) 4 très souvent (49)
workexp/work	Combien d'heures par semaine travailles-tu à un travail pour lequel tu reçois un salaire?
2parent	Avec qui vis-tu actuellement? 1 avec mes deux parents naturels (365) 2 avec mon père naturel seul (26) 3 avec mon père naturel et une personne qui n'est pas ma mère naturelle (37) 4 avec ma mère naturelle seule (107) 5 avec ma mère naturelle et une personne qui n'est pas mon père naturel (91) 6 avec d'autres membres de ma parenté (5) 7 avec mes parents adoptifs (1) 8 en famille d'accueil (3) 9 autre (spécifier) (23)

church	<p>Est-ce que tu vas à l'église?</p> <p>1 plusieurs fois par semaine (6)</p> <p>2 une fois par semaine (16)</p> <p>3 une ou deux fois par mois (30)</p> <p>4 seulement lorsque il y a une occasion spéciale (exemple: mariage, enterrement) (304)</p> <p>5 jamais (302)</p>
friend	<p>Le garçon qui est ton meilleur ami s'est-il déjà fait arrêté par la police?</p> <p>1 oui (224)</p> <p>2 non (340)</p> <p>3 je n'ai pas de meilleur ami (94)</p>
adult	<p>Combien d'adultes criminels connais-tu personnellement?</p> <p>1 aucun (394)</p> <p>2 un ou deux (171)</p> <p>3 quelques-uns (64)</p> <p>4 plusieurs (29)</p>
bro/sis	<p>Est-ce qu'un de tes frères ou une de tes soeurs s'est déjà fait arrêté par la police parce qu'il avait fait un mauvais coup?</p> <p>1 oui, un frère (73)</p> <p>2 oui, une soeur (20)</p> <p>3 non, jamais (439)</p> <p>4 je ne le sais pas (28)</p> <p>5 je n'ai pas de frère ou soeur (98)</p>
pmoney	<p>Habituellement, combien d'argent de poche reçois-tu de tes parents chaque semaine?</p> <p>1 rien (135)</p> <p>2 moins de deux dollars par semaine (12)</p> <p>3 2\$ à 5\$ par semaine (88)</p> <p>4 6\$ à 10\$ par semaine (168)</p> <p>5 11\$ à 20\$ par semaine (155)</p> <p>6 21\$ à 30\$ par semaine (58)</p> <p>7 31\$ à 40\$ par semaine (18)</p> <p>8 41\$ à 50\$ par semaine (11)</p> <p>9 51\$ à 100\$ par semaine (6)</p> <p>10 plus de 100\$ par semaine (7)</p>

MAP OF REGIONS IN QUEBEC

APPENDIX 4C

This appendix provides test results of multicollinearity using auxiliary R^2 . Auxiliary R^2 is generated by regressing each explanatory variable on all other explanatory variables. A high auxiliary R^2 , therefore implies multicollinearity. Table B provides the results for both the cross-section and panel data.

TABLE 4C
RELATIONSHIP BETWEEN EACH EXPLANATORY VARIABLE AND OTHER EXPLANATORY VARIABLES MEASURED BY AUXILIARY R^2

Explanatory variables	Auxiliary R^2	
	cross-section data	panel data
French	0.6986	(used only in cross-section data)
math	0.6716	(used only in cross-section data)
motivation	0.2837	0.1426
inclass	0.6137	0.2173
inchool	0.5681	(used only in cross-section data)
workexp	0.0657	(used only in cross-section data)
work	(used only in panel data)	0.0135
pmoney	0.0306	0.0096
2parent	0.0772	0.0409
church	0.1181	0.0707
friend	0.2205	0.1665
adult	0.1802	0.1734
bro/sis	0.0581	0.0648
urate	0.6392	(used only in cross-section data)
policeexp	0.6351	(used only in cross-section data)

As shown by the results from Table 4C, multicollinearity is detected between the school variables "French," "math," "inclass," and "inschool," where their auxiliary R^2 range from 0.5681 to 0.6986 from the cross-section data. Further examination shows that multicollinearity is likely to be between two pairs of school variables: (1) "French" and "math"; and (2) "inclass" and "inschool." When "math" is removed from the regression using "French" as the dependent variable, the corresponding auxiliary R^2 is reduced from 0.6896 to less than 0.5. When "inschool" is removed from the regression using "inclass" as the dependent variable, the corresponding auxiliary R^2 is reduced from 0.5681 to less than 0.3. Therefore, only the variables "motivation" and "inclass" are used for the panel data and the bivariate probit analyses to minimize multicollinearity between the school-related variables. Multicollinearity is also detected between "urate" and "policeexp." However, removal of either of these variables does not have any major impact on the statistical significance of these variables in explaining delinquency.

Chapter 5

Schooling and Delinquency

The general economic literature is interested in schooling primarily as a factor to increase future earnings as in human capital theory (Becker, 1964). The economics of delinquency literature is interested in schooling as a potentially important factor in moderating delinquent behaviour (Phillips and Votey, 1987b; Viscusi, 1986.). The major goal of this chapter is to apply the theoretical model developed in Chapter 3 to empirically examine the relationship between these two related concepts.

Students face the daily decision of whether to skip school or not. For many individuals, the choice of school time is not simply binary (attend or not) since they decide the number of school days and/or the number of classes to attend daily. The amount of time spent on schooling is decided at the same stage as is the time spent on all other (out-of-school) activities. Individuals decide on the amount of time spent in school by weighing the costs and benefits derived from school attendance.

In this chapter we examine how delinquency decisions interact with other social capital variables to affect school attendance. Most empirical analyses consider schooling to be the discrete choice between quitting and staying in school and then explore the effect of that decision on the level of delinquency. This all-or-nothing choice is used in most studies primarily because of limitations in the availability of data. The database used in this research allows for a much more detailed analysis. "Inclass" and "inschool" from the

last chapter will be used as the dependent variables in this chapter. For example, adolescents who frequently miss school altogether and those who frequently skip classes may already exhibit delinquent behaviour. Models that distinguish only all-or-nothing schooling decisions cannot capture such a gradation of differences. Since the variables “inclass” and “inschool” each has five categories, the ordered logit model is used for the analysis. Theoretical implications derived from the comparative statics exercises in Chapter 3 are used as testable hypotheses for empirical examination. The explanatory variables used in this chapter are same as those in the last chapter. The analysis will begin by using class/school attendance to estimate individual schooling decisions. Then the analysis will proceed to analyse the schooling decision and delinquency participation jointly using the bivariate probit model.

5.1 Empirical Analysis

The analysis from Chapter 3 predicts that crime-productive social institutions and capital such as delinquent friends, criminal adult associates, and delinquent brother(s) and/or sister(s) will have negative impacts on the amount of time spent in school. School-productive activities and capital such as the intention to pursue studies beyond high school have positive impacts on the amount of time spent in school. These theoretical implications are used as testable hypotheses for empirical examination in this chapter. The empirical relationships between different institutional variables and delinquency participation were discussed in the last chapter.

This chapter formulates three measures of school/class attendance as dependent variables for comparison purposes. The definitions and summary statistics of the variables are provided in the previous chapter. The theoretical model assumes that adolescents use schooling to increase their future earnings. The model assumes that more time spent in school (t_i) will increase future earning (w_i) such that $\partial w_i / \partial t_i > 0$. The database used in this research provides different proxies for t_i , such as frequency of missing school and skipping classes. There is, however, no direct measure of future earnings available from the database. Percentage grades in French and Mathematics from the previous school year are therefore used to proximate future earning potentials, assuming that students who earn higher grades will face higher future earnings and vice versa. The relationship between grades and time spent in school⁵¹ is discussed in Appendix 5A.

Schooling decision

This section considers the effects of capital generated from various social institutions on the amount of time spent in school. In the following estimations, the binary logit and probit models are used, where the dependent variable is a 0-1 dummy

⁵¹Recent research examined the relationship between class attendance and school performance of university students. Significant positive relationships are reported between the two factors (Durden and Ellis, 1995; Park and Kerr, 1990; Romer, 1993; Schmidt, 1983). Lamdin (1996) pointed out that most studies of student performance do not consider student attendance as an independent variable. Lamdin used data from kindergarten and elementary students and reported significant positive relationship between class attendance and school performance. Wenger (2000) considered test scores and graduation rates as outputs from schooling and examined the effects of different factors on these outputs.

variable such as “schooling.” For variables with more categories such as “inschool” and “inclass,” the ordered logit and probit models are used. The definitions of the dependent variables are summarized in Table 5.1.

TABLE 5.1
DEFINITIONS OF THE DEPENDENT VARIABLES

variables	definition
schooling	1 if the individual was still going to school at the age of 17, 0 otherwise.
inclass	a 5-category scale indicating the frequency of class attendance.
inschool	a 5-category scale indicating the frequency of school attendance.

The binary choice model generates estimates by maximizing the following log-likelihood functions,

$$\ln L = \sum \left[Y_i \ln \left[\frac{\exp(BX)}{1 + \exp(BX)} \right] + (1 - Y_i) \ln \left[\frac{1}{1 + \exp(BX)} \right] \right],$$

where Y_i = attendance and the regression equation can be written as

$$\begin{aligned} BX = & \beta_1 + \beta_2 (\text{motivation}) + \beta_3 (\text{workexp}) + \beta_4 (\text{pmoney}) + \beta_5 (2\text{parent}) \\ & + \beta_6 (\text{church}) + \beta_7 (\text{friend}) + \beta_8 (\text{adult}) + \beta_9 (\text{bro/sis}) + \beta_{10} (\text{urate}) \\ & + \beta_{11} (\text{policeexp}) \end{aligned}$$

The definitions of the variables can be found in Chapter 4. The slope coefficients, the β_i 's,

are interpreted as the change in the log-odds in favour of school attendance as an explanatory variable changes by a unit.

The ordered logit model will be used when the dependent variable is a multi-category ranked variable with M categories such as “inclass,” and “inschool.” The ordered logit model can be similarly estimated as in the binary case by maximizing the log-likelihood functions as follows,

$$\ln L = \sum \ln [\Pr(Y_i = 0 \mid \beta, x_i, \mu)] + \sum \ln [\Pr(Y_i = 1 \mid \beta, x_i, \mu)] - \dots \\ + \sum \ln [\Pr(Y_i = M \mid \beta, x_i, \mu)]$$

where x_i is the vector of explanatory variables, β is the vector of coefficients, and μ is a vector of parameters that define the bounds or limits of each of the ordered categories of the dependent variable. In principle, the boys in the sample could respond to the survey questions about skipping classes and missing school with their own Y if they are asked to do so. Given only with five choices, however, they choose the cell that most closely represents their own feelings on the questions (Greene, 2000). The regression results are provided in Table 5.2⁵².

⁵²Since the marginal effects for the ordered model are calculated for each of the four categories of the dependent variables, they are lengthy and will be provided only upon request.

TABLE 5.2
FACTORS AFFECTING TIME SPENT IN SCHOOL

explanatory variable	schooling (binary)		inclass (ordered)		inschool (ordered)	
	Logit	Probit	Logit	Probit	Logit	Probit
motivation	4.5322*** (4.43)	2.0406*** (5.45)	0.8620*** (4.88)	0.5664*** (5.51)	1.0435*** (6.06)	0.6395*** (6.44)
workexp	0.5330* (1.37)	0.2762* (1.28)	-0.2261* (-1.43)	-0.1101 (-1.18)	-0.0563 (-0.38)	-0.0260 (-0.29)
pmoney	0.0769 (0.85)	0.0378 (0.76)	-0.0085 (-0.21)	-0.0038 (-0.17)	-0.0129 (-0.33)	-0.0018 (-0.08)
2parent	0.9740*** (2.37)	0.5673*** (2.49)	0.1437 (0.91)	0.0971 (1.04)	0.3871*** (2.57)	0.2205*** (2.49)
church	0.2760 (0.68)	0.1727 (0.77)	0.1730 (1.08)	0.1193* (1.28)	0.4996*** (3.26)	0.2990*** (3.31)
friend	-1.4404*** (-3.13)	-0.8023*** (-3.26)	-0.9074*** (-5.24)	-0.5320*** (-5.20)	-0.8707*** (-5.22)	-0.5167*** (-5.26)
adult	0.2425 (0.55)	0.1279 (0.53)	-0.2996** (-1.78)	-0.1693** (-1.71)	-0.3542** (-2.19)	-0.1960** (-2.05)
bro/sis	-0.0304 (-0.07)	-0.0331 (-0.13)	-0.1706 (-0.77)	-0.0914 (-0.70)	-0.2175 (-1.02)	-0.1372 (-1.10)
urate	0.0235 (0.16)	0.0057 (0.07)	0.1854** (2.19)	0.0966** (2.11)	-0.0415 (-0.57)	-0.0258 (-0.62)
policeexp	-0.0018 (-0.33)	-0.0006 (-0.21)	-0.0017 (-0.59)	-0.0006 (-0.38)	-0.3309 (-0.34)	-0.0003 (-0.19)
value of log likelihood function	-93.16	-92.8	-729.66	-724.85	-847.3	-842.84
LR statistics	126.06	126.79	102.48	112.1	145.99	154.92
observations	658	658	658	658	658	658

***significant at 1% level

**significant at 5% level

*significant at 10% level

The estimation results from Table 5.2 show that the coefficients of the capital-generating institutional variables are significant in the expected direction in some cases, depending on the dependent variable used. "Motivation" is shown to have a significant positive relationship with school attendance across different model specifications. This implies that a positive attitude towards school and the intention to pursue higher education increases the likelihood of school attendance. Note that grades in "math" and French" from the previous year are not used in the analysis due to their multicollinearity with "motivation."

Work experience in the recent past is shown to have no significant relationship with school attendance in three of the six cases presented. Mixed results are found for the rest of the cases, implying that there may exist opposing effects of work experience on the schooling decision. On the one hand, early work experience may complement learning from school as a form of practical application and therefore provide better incentive for school attendance. On the other hand, paid market work may be particularly attractive to present-oriented individuals who do not value much of investment in schooling. The estimation results from Table 5.2 also show that the amount of pocket money has no significant impact on school attendance.

The presence of both biological parents ("2parent") significantly increases the probability of being a student and the number of school days attended per school year. However, results from Table 5.2 also show that "2parent" has no significant impact on the number of classes attended per school day. This is an interesting finding on parental

monitoring. The results imply that while parents seem to be able to control in keeping their children in school, they are less able to keep their children from skipping classes.

Church attendance has a significant relationship with “inschool,” but not with “student” and “inclass.” This implies that church attendance cannot affect the probability of a teenager dropping out of high school or the number of classes attended per day, but can increase the number of school days attended by an adolescent. This shows that church certainly still have an effect on school attendance.

The presence of a best friend who is delinquent (“friend”) is shown to have a significant negative relationship with school attendance in all six cases. Adolescents who have best friends who are delinquents are less likely to stay in school and go to school and classes less often. Adolescents who know criminal adults are also found to be significantly less likely to attend school and classes. The presence of brother(s) and/or sister(s) who is/are criminal(s) has no significant relationship with either staying in school or the frequency of attending school and classes.

Structural variables such as unemployment rate and police expenditure are found to have no significant relationship with schooling decision, with only one exception. Results from Table 5.2 show that there exists a significant positive relationship between “urate” and “inclass,” implying that a higher unemployment rate significantly increases the number of classes attended by an adolescent per day. This suggests that higher unemployment rate implies fewer market work opportunities. Teenage workers, many of them part-time workers, are often the first to lose their jobs during economic recessions. When there is no job, more time is available to all other activities, including time spent

going to classes.

The LR statistics are significant at the 1% level across different model specifications, implying that the null hypothesis that all slope coefficients are equal to zero can be rejected. As discussed above, different factors appear to be important determinants of schooling decision to certain extent. Tendencies to pursue higher education, family structure, church attendance, the presence of delinquent friends and adult criminals, all have some effects on schooling decisions. The next section is to examine schooling decision and delinquency participation as a joint decision process.

Joint decision on schooling and delinquency participation

The analysis so far has focussed on the discussion of the schooling decision. Such analysis allows us to examine by the effects of various factors on different measures of the schooling decision. In doing so, it is assumed that the schooling decision is independent of other time use decisions. The theoretical model from chapter 3, however, assumes that adolescents maximize utility by allocating a fixed amount of time available to different uses including time spent in school, time spent on delinquency, and time spent on market work. The three choices are assumed to be made simultaneously as a joint decision, which resembles better real life decision making.

The first case presented here uses three dependent variables: self-reported delinquent behaviour ("sjd") to indicate whether an individual self-reported his delinquency; schooling choice ("schooling") to indicate whether an individual was still going to school at 17 years old; and the work choice ("market work") to indicate whether the individual was employed in market work. All three dependent variables are 0-1

dummy variables to indicate participation versus non-participation in each of the three activities. The multivariate probit model is therefore used, and the coefficients with their corresponding t-statistics in parantheses are provided in Table 5.3.

TABLE 5.3
EFFECTS OF VARIOUS FACTORS ON SCHOOLING, DELINQUENCY,
AND MARKET WORK: A MULTIVARIATE PROBIT ANALYSIS

Variables	Delinquency	Schooling	Market Work
motivation	-0.3087*** (-2.53)	1.9915*** (4.51)	0.2506*** (2.01)
workexp	0.2474** (2.22)	0.2904 (1.04)	0.9278*** (7.82)
pmoney	0.0427* (1.57)	0.0305 (0.65)	-0.0921*** (-3.30)
2parent	-0.2066** (-1.87)	0.5438*** (1.99)	0.2024** (1.79)
church	-0.1644* (-1.44)	0.1471 (0.59)	0.0757 (0.66)
friend	0.6405*** (5.17)	-0.7264*** (-2.53)	-0.0499 (-0.41)
adult	0.6416*** (5.57)	0.0896 (0.31)	0.0912 (0.77)
bro/sis	0.1250 (0.76)	-0.0522 (-0.19)	-0.0234 (-0.15)
urate	-0.0664 (-1.17)	0.0128 (0.13)	-0.0745* (-1.49)
policeexp	0.0009 (0.47)	-0.0003 (-0.08)	0.0027* (1.60)
correlation coefficient (ρ)	delinquency and schooling	-0.0850 (-0.49)	
	delinquency and work	-0.1154** (1.64)	
	schooling and work	0.6437*** (3.63)	
value of log-likelihood function		-830.62	
observations		658	

***significant at the 1% level (1-tailed test)

**significant at the 5% level (1-tailed test)

*significant at the 10% level (1-tailed test)

The results from Table 5.3 show that intention to pursue studies beyond high school (“motivation”) and living with both biological parents (“2parent”) have significant positive relationships with work, implying that both factors can represent institutions that promote the accumulation of work-productive capital. Not surprisingly, recent work experience also has a significant positive relationship with market work in the current period. The analysis also shows that the larger the amount of pocket money obtained, the less likely that an adolescent will participate in market work. Unemployment rate is also shown to have a negative relationship with the likelihood of participating in market work. Interestingly, larger police spending tends to encourage participation in market work, perhaps implying that criminal income may be less feasible with the increase in police spending.

The correlation coefficient (ρ) measures the correlation between the dependent variables after the influence of the explanatory factors is accounted for (Greene, 2000, p. 854). The correlation coefficient (ρ) between delinquency and schooling is shown to be statistically insignificant.⁵³ The correlation coefficient between delinquency and work is shown to be significantly positive at the 5% level. The correlation coefficient between schooling and work is shown to be significantly positive at the 1% level.

The effects of various factors on delinquency and schooling are largely consistent with estimation results from the univariate analysis presented earlier. A bivariate probit

⁵³“Motivation” is a factor that is highly significant in affecting the schooling decision. This is perhaps not surprisingly since “motivation” is a measure of attitude towards school. When “motivation” is removed from the system of the bivariate probit model to get rid of all potential influences from school in the delinquency equation, ρ then becomes statistically significant at the 5% level, implying that there exists a strong correlation between delinquency and schooling decision. The size of the other coefficients, however, do not alter significantly after the removal of “motivation” from the analysis.

analysis using delinquency and schooling as the dependent variables is provided next for comparison purposes. The estimation results are shown in Table 5.4.

The results from Table 5.4 show that intention to pursue further studies beyond high school ("motivation") has a significant negative impact on delinquency participation and a significant positive impact on the schooling decision. This implies that a positive attitude toward school is important in both controlling delinquency and providing the incentive to stay in school. The probability of an adolescent being a delinquent decreases by about 12% and the probability of being a student at 17 years old increases by 4% if the individual has the motivation to pursue study beyond high school.

Market work experience ("workexp") is found to have a positive relationship with delinquency participation and no significant relationship with the schooling decision. In particular, the probability of being a delinquent increases by almost 10% if an adolescent had accumulated some market work experience between the ages of 14 and 16. One possible reason is that the market work provides easy access to properties of other people, and therefore may encourage the participation in property crime (Birkbeck and Lafree, 1993). Another possible explanation is that adolescents who work at an early age may have taste for expensive goods such as designer's clothing and cigarettes, and have the attitude that "more is always better." This attitude will lead them to exploit different sources of obtaining money, therefore working and stealing at the same time. On the other hand, the estimation results suggest that market work experience has little impact on the decision of whether staying in school or not. The amount of pocket money ("pmoney") is found to have a significant positive relationship with delinquency, but no significance in the determination of the schooling decisions.

TABLE 5.4
EFFECTS OF VARIOUS FACTORS ON SCHOOLING AND DELINQUENCY
A BIVARIATE PROBIT ANALYSIS

Variables	Delinquency		Schooling	
	coefficient	marginal effect	coefficient	marginal effect
motivation	-0.3092*** (-2.55)	-0.1218***	2.0289*** (4.62)	0.0406***
workexp	0.2485** (2.27)	0.0979**	-0.2777 (-1.04)	-0.006
pmoney	0.0441* (1.65)	0.0174*	0.0366 (0.77)	0.001
2parent	-0.2080** (-1.90)	-0.0820**	0.5519** (2.02)	0.0110**
church	-0.1620* (-1.44)	-0.0638*	0.1763 (0.72)	0.0035
friend	0.6417*** (5.25)	0.2529***	-0.7690*** (-2.73)	-0.0154***
adult	0.6431*** (5.62)	0.2535***	0.0962 (0.33)	0.0019
bro/sis	0.1247 (0.78)	0.0491	-0.0488 (-0.17)	-0.001
urate	-0.0646 (-1.20)	-0.0258	0.0109 (0.91)	0.0002
policeexp	0.0009 (0.46)	0.0003	-0.0007 (-0.25)	-0.0001
correlation coefficient (ρ)	-0.1037 (-0.58)			
value of log- likelihood function	-470.99			
observations	658			

***significant at the 1% level (1-tailed test)

**significant at the 5% level (1-tailed test)

*significant at the 10% level (1-tailed test)

The presence of both biological parents is found to significantly decrease the probability of being a delinquent by about 8% and significantly increase the probability of being a student by about 1%. This implies that a healthy family environment is important

in different aspects of the life of an adolescent. Church attendance is found to significantly reduce the probability of delinquency by about 6%.

The presence of a delinquent best friend is found to have a significant positive effect on delinquency participation, and a significant negative effect on the schooling decision. The marginal effect shows that the presence of a delinquent best friend or other adult criminal associates can increase the probability of an adolescent being a delinquent by about 25%. Presence of adult criminals, however, is shown to have no significant relationship with the probability of an adolescent being a student. These results are perhaps not surprising when we take into account the role of peer pressure. An adolescent is likely to be lured into delinquent acts when such behaviour is supported and encouraged by a best friend. Truancy can be considered one form of delinquent behaviour which is likely to be supported by a delinquent friend. The behaviour may start with skipping classes and then eventually leading to dropping out of school. Therefore, the presence of a delinquent best friend decreases the probability of an adolescent staying in school. The presence of criminal brother(s) and/or sister(s) has no significant impact on either delinquency or the schooling decision.

Structural variables such as unemployment rate and the level of police expenditure are shown to have no significant relationship with either delinquency or the schooling decision. An increase in unemployment rate may decrease the expectation on market wage (w_t) which in turn decreases the opportunity cost of time spent on delinquency (t_t). The theoretical model from Chapter 3 therefore predicts that an increase in unemployment rate increase the time spent on delinquency. Furthermore, high unemployment rate may also worsen the problem of inequality which is one of the driving forces of property crime. Results on unemployment rate, however, may have more complicated implications. A

higher unemployment rate may imply a decrease of wealth circulated in the economy, and therefore decreases the opportunities for property crime⁵⁴ (Bogen, 1944; Birkbeck and Lafree, 1993). The statistically insignificant results regarding unemployment rate may be due to the fact that opposite forces are at work. Depending on the measure used for schooling decision, it was shown earlier that certain effect may outweigh others and give statistically insignificant results.

The correlation coefficient (ρ) of the bivariate probit model between delinquency and schooling is shown to be negative but statistically insignificant. It does not mean that delinquency and schooling decisions are independent of each other, but it implies that the correlation between the two decisions is weak after accounting for the explanatory factors included in the analysis.⁵⁵ This fact can also be tested by examining whether the coefficients of the variables are different between the univariate probit and the bivariate probit models. The coefficients of variables from “schooling” of the bivariate probit model in Table 5.4 will be used as the null hypotheses to test against coefficients of variables from “schooling” of the univariate probit model in Table 5.2. The statistics of the Wald Chi-square statistics are provided in Table 5.5.

⁵⁴Empirical evidence from earlier literature also provide mixed results. See Chapter 2 for a literature survey.

⁵⁵As mentioned earlier, the correlation between schooling and delinquency becomes stronger once “motivation” is eliminated as an explanatory variable from the analysis.

TABLE 5.5
WALD CHI SQUARE STATISTICS TO TEST THE DIFFERENCES BETWEEN THE
COEFFICIENTS OF THE UNIVARIATE AND BIVARIATE PROBIT MODELS

variable	Wald Chi-square statistics
motivation	0.3366
workexp	0.0001
pmoney	0.0006
2parent	0.0046
church	0.0003
friend	0.0182
adult	0.0171
bro/sis	0.0038
urate	0.0038
policeexp	0.0007

The results from Table 5.5 show that there are no significant difference between the estimates from the univariate and the bivariate probit models. These findings are consistent with the fact that the correlation coefficient of the bivariate probit model is statistically insignificant. However, bivariate and multivariate probit analyses are designed to examine joint-decision models as suggested by the theory in Chapter 3 and therefore are more appropriate estimation techniques than univariate probit analysis.

The results obtained from the bivariate probit analysis are largely consistent with earlier empirical findings when delinquency and schooling decisions are modelled separately. This does not necessarily imply that decisions on delinquency and schooling participation are independent on each other. It was mentioned earlier that there is a significant negative relationship between the two decisions once all the school-related

factors are eliminated from the analysis as explanatory variables.

Under the joint decision model using “schooling” to represent the schooling choice, the only significant determinants of schooling decision are “motivation,” “2parent,” and “friend.” Other factors such as “church” and “adult” are found to be statistically insignificant. This does not mean, however, that “church and “adult” plays no role in the schooling decision, it is shown earlier in the single decision model that “church” and “adult” may have significant relationships when alternative definitions for the schooling decisions are used.

5.2 Conclusion

The purpose of this chapter is to examine the relationship between the schooling decision and different types of social influences from family, church, and peers, in addition to attitude towards school. The analysis used the theoretical implications presented in Chapter 3 as testable hypothesis for empirical examination. The theory implies that school-productive capital variables such as family, church, and positive attitude towards school are expected to have positive effects on the amount of time spent in school. Crime-productive capital variables such as delinquent peers and associates are expected to have negative effects on the amount of time spent in school.

The empirical analysis of this chapter shows that influences from family, church, peer, and attitudes towards school can all be important determinants of the amount of time spent in school depending on the definition of the dependent variables. Delinquency and schooling decisions are found to have a weak correlation from the bivariate probit model. This does not mean that delinquency and schooling decisions are independent of each other. In fact, it has been shown that attitude toward school (“motivation”) has a

significant negative impact on delinquency. This implies that getting adolescents more involved in school may indeed help to reduce the level of delinquent activities.

Not surprisingly, positive attitude towards school also appears to have the most significant impact on school attendance throughout the analysis. Other social influences from family, church, and peers are also shown to have important influences on the schooling decision one way or the other. The level of police expenditure, on the other hand, remains to have no significant impact on school attendance or the level of delinquent behaviour. These findings have important policy implications. Social welfare programs designed to help troubled youth by keeping them in school, strengthening their family environment and keeping them away from other criminals and delinquents may be more sound policies than increasing the level of police resources.

APPENDIX 5A

RELATIONSHIP BETWEEN GRADES AND TIME SPENT IN SCHOOL

Our data set allows two measures of the independent variable for school attendance: the frequency of attending classes during a regular school day ("inclass"); and the frequency of school is attended ("inschool"). The independent variable "grade," is the average percentage score in French ("French") and Mathematics ("math"). We begin by showing that in our data set school attendance does result in higher grades (which is assumed to generate higher future earnings). Table 1 shows the regression results of the relationship between grade and school attendance, with the t-statistics in parentheses.

TABLE 5A

RELATIONSHIP BETWEEN GRADE AND SCHOOL ATTENDANCE

explanatory variable	(1)	(2)	(3)
inclass	12.6427*** (21.33)	-----	10.0178*** (11.96)
inschool	-----	10.0711*** (16.81)	3.4057*** (4.38)
R-squared	0.4096	0.3011	0.4264
observations	658	658	658

***significant at the 1% level

The estimation results of Table 5A use "grade" as the dependent variable to measure school performance. Different measures of school attendance are used as the independent variables. Not only do the results show that the different measures of school attendance are significant determinants of grade as revealed by the t-statistics, but the

results further show that school attendance can explain about 30% to 40% of the higher grade achieved in school, as reflected by the r-square measure. Because the amount of time spent in school is such an important determinant of school performance as measured by grade, and because of the strong connection between current grades and future earnings, the analysis that follows tests the hypotheses generated from the theory by the amount of time spent in school as the dependent variable.

Chapter 6

Official Juvenile Delinquent Record

An important principle in the new Youth Criminal Justice Act introduced by the Government of Canada is to ensure that “there are meaningful consequences that encourage accountability for offences committed by youth.” (Department of Justice Canada, 1999). In the new act, there appears the general theme of getting tough on youth crime, for example, by lowering the age of youth who can be transferred to adult court from 16 to 14. Penalty and conviction seem to be the emphasis. At present, however, not much is known about how or why individuals acquire a record for juvenile delinquent offences. In the previous chapter we have looked at the effects of some underlying individual social characteristics on self-reported delinquent behaviour. The purpose of this chapter is to examine the factors that lead to the acquisition of an official juvenile delinquency record, in particular, the relationship between official delinquent record, self-reported delinquent behaviour, and individual social characteristics.

It has long been recognized that many criminal and delinquent activities are neither detected by nor reported to the police (Short and Nye, 1958; Dunford and Elliott, 1984; Huizinga and Elliott, 1987; Huizinga, Loeber, and Thornberry, 1994). For example, in our sample of Montréal youth studied, nearly every individual reported committing at least one

form of delinquent behaviour between the age of 10 and 17⁵⁶ (see the 27 self-reported delinquency items described in the next section). On the other hand, only about 12% had been charged and convicted for a criminal or status offense, such as drinking under age⁵⁷, and are officially recorded as juvenile delinquents. This observation raises the interesting question of what are the factors leading to convictions.

Part of the answer to the puzzle lies with the discretionary power of the police and the court. For example, a police officer can exercise discretion after investigating into a case dealt with a young person. Section 6 of the new Youth Criminal Justice Act implies that a police officer can decide to take no further action, warn the young person, administer a caution, or lay charges (Canadian Center for Justice Statistics, 1998). Moreover, the Crown counsel has the power to stay or withdraw any charge and therefore prevent further proceedings in the court (Corrado and Markwart, 1996). Once a young person is charged and is brought to the court, youth court judges can exercise their discretionary power to decide on the disposition (Alvi, 2000; Corrado and Markwart, 1996). For instance, Doob, Marinos, and Varma (1995) reported that youth court judges follow quite different "ideologies," ranging from punishment, to rehabilitation, to deterrence, in handing down dispositions. An experiment conducted by Doob and

⁵⁶All forms of delinquencies discussed in this research can be classified as criminal offences according to *The 2000 Annotated Tremeeam's Criminal Code*.

⁵⁷Although the Quebec region experienced a slight increase in male youth processed through the youth court system between 1992/93 and 1996/97, the Quebec region remains to have the fewest youth charged by the police compared to other provinces. For more details, see Table 1.3 of Sinclair and Boe (1998).

Beaulieu (1992) shows that there exists a lot of variations on sentencing decisions between different judges when given similar cases.

Discretion matters because it is costly to investigate and solve every crime. From an economic perspective, the objective of police is to minimize search cost or to maximize cases resolved by employing resources in the most efficient way. Various methods can be used to minimize search cost, for example, begin by investigating ex-convicts. The term “profiling” was originally established for the “war on drugs” programs in the United States. “Profiling” refers to individual behavioural characteristics used by police to choose potential suspects. Some researchers believe that police officers may use race to decide who to investigate (Harris, 1999). For example, in choosing who to pull over for “breath tests,” officers will be more likely to stop those with the “background characteristics” of erratic driving.

The practice of profiling is similar to what is known as statistical discrimination in the literature, that is treating two individuals differently on the basis of the characteristics of the group they belong to (Blau, Ferber and Winkler, p.186). There exists a large body of literature that presents evidence on racial differential treatment on the basis of race by the police and the court. In a literature survey on racial discrimination in the criminal justice system, Weitzer (1996) reported that Black youths are more frequently stopped by police and are more likely to be arrested than White youths. Wordes and Bynum (1995) presented similar evidence by concluding that Black juveniles are more likely to be referred to the court by the police than White juveniles. Carrington (1998) concluded from Canadian evidence that youth of aboriginal origins are more likely on average to be

charged by police. At the trial level, Weitzer (1996) further reported that defendants of African-American decent are convicted more frequently and sentenced more harshly than their White counterparts.

There do exist evidence that the police and the court may use age as a factor to make their arrest and conviction decisions. For instance, Carrington (1998) found that apprehended youths who were 17 years old were twice as likely as 12 years olds to be charged and much of this relationship is due to differential treatment of older youth in Canada. Wordes and Bynum (1995) used data from Michigan and found that older juveniles are more likely than the younger counterparts to be referred to the courts by the police while younger juveniles are more likely to be handled informally. Similar findings are also obtained using Australian data (Hancock, 1978). Hancock found that older juveniles are more likely to be referred by the police for court appearance than younger juveniles. Using data from Minnesota, Feld (1995) found that older adolescents are more likely to be committed to secure confinement than younger adolescents by the court.

There are also evidence that male youths are treated differently than female youths by the criminal justice system. Self-reported studies indicate that female delinquency is more similar to male delinquency than official records suggested (Chesney-Lind and Shelden, 1998; Rowe et al., 1995). The literature has shown mixed evidence on differential police and court treatment by gender. For instance, males are more likely than females to be arrested for major felonies, but females are far more likely than males to be arrested for prostitution (Monahan, 1970; Horowitz and Pottieger, 1991). Researchers have also found that the court tends to impose harsher sentences on runaway females than their male counterparts (Shelden and Horvath, 1986).

What are the explanations for this phenomenon? Do individuals with certain characteristics commit more crime, or do they simply get caught by police and convicted by the court more often? Are there any reasons for the police to devote a disproportionate amount of their resources in the investigation of young people with certain social characteristics? Are there any reasons for the court to convict juveniles with certain individual backgrounds? This chapter attempts to provide some possible answers to these questions.

In this chapter, we will look at the relationship between the acquisition of an official delinquent record and three groups of variables, namely (1) self-reported delinquent behaviour, (2) individual social characteristics, and (3) regional characteristics. Previous studies have already suggested the important relationship between individual social characteristics and official delinquent record. I will further argue in this chapter that this relationship continues to be important even after controlling for the level of self-reported delinquency and regional characteristics. A theory is motivated next for the phenomenon, followed by some empirical findings and policy implications using the Montréal Longitudinal study.

6.1 Theory

This section applies the theory of statistical discrimination (Phelps, 1972) to model the arrest and conviction decisions of the police and the court. If law enforcement by police and the court were perfectly effective, all crimes would be punished. If all people were honest, then self-reported delinquent behaviour would be the best indicator of the

probability of acquiring an official delinquency record. More generally, the relationship between having an official delinquent record and self-reporting delinquency behaviour can be represented as follows:

$$(6.1) \quad y = g(q),$$

where y is the probability of acquiring an official delinquent record, q represents the vector of different forms of self-reported delinquent behaviour. Thus, in a world of perfect law enforcement and perfect honesty, g would be an appropriate unit vector.

Statistical Discrimination

The world, however, is far from perfect. Even if individuals report their behaviour with perfect accuracy, police still face certain constraints on their ability to investigate. For example, it is extremely costly to investigate all “minor” crimes and to keep an eye on all individuals. The court may also not want to convict all the individuals who are processed and charged. For instance, judges may make decisions by speculating on the likelihood of future delinquency based on experience with previous cases. Charges on first-time offenders who commit relatively minor offences may be dropped if the court expects that these individuals will not commit another offence.

To minimize costs, the police and the court may concentrate arrests and convictions on certain crimes and/or individuals based on decisions from previous cases. For example, the police and the court, based on previous experience, may form an

expectation that individuals with certain characteristics and backgrounds, such as blacks, are more likely to commit crimes than others (Farrington et al., 1996; Hancock, 1978; Walker, Spohn, and DeLone, 1996; Weitzer, 1996; Wordes and Bynum, 1995). To the extent that they act only on their expectation, these expectations will become beliefs and self-fulfilling prophecies regardless of whether they are true or not. In this case, blacks will be arrested and convicted disproportionately for their criminal activities and thus have a higher probability of obtaining a criminal record. When the police and the court focus their investigation and conviction efforts on certain groups, the affected groups face a much higher probability of acquiring an official record, and therefore higher reported crime rates, justifying the original expectation.

If law enforcement is imperfect, the police and the court rely on criteria other than that which produces delinquent behaviour in making their decisions, and then these other criteria will also enter the relationship explaining the probability of acquiring an official delinquent record such that:

$$(6.2) \quad y = g(q, z),$$

where z represents the vector of other criteria used by police and court in crime fighting.

Equation (6.2) suggests that there are two groups of factors that can affect the probability of acquiring an official delinquency record: (1) actual or self-reported delinquent behaviour, and (2) other criteria used by the police and the court such as social characteristics of individuals. The significance of the latter can be thought of indicating the

presence of statistical discrimination in law enforcement and crime fighting.

This study assumes that it is meaningful to partition the data into two sets of factors that can affect the probability of acquiring a delinquency record, self-reported delinquent behaviour and individual social characteristics that could be used by police and courts as indicators of an individual's probability of delinquent behaviour. The theory of statistical discrimination will be tested empirically using the data provided by the Montréal Longitudinal Study in the next section by looking for the additional significance of other social indicators.

6.2 The Montréal Study

Data

As mentioned in earlier chapters, the database used in this dissertation is the Montréal Longitudinal Study.⁵⁸ The definitions of the items used in this chapter are provided in Table 6.1 and their descriptive statistics in Table 6.2. Frequency distribution of the original survey questions for the self-reported delinquent items are provided in Appendix 6A. 656 individuals were used for the analysis of this chapter.

⁵⁸Chapter 4 contains a more extensive discussion of the database.

TABLE 6.1
DEFINITIONS OF VARIABLES

Variable	Definition
ojd	1 if some forms of official delinquent record(s) were acquired between the age of 10 and 17. 0 otherwise.
beatup1	1 if self-reported beating up somebody to force someone to do something. 0 otherwise.
strongarm	1 if self-reported strong arm in fights. 0 otherwise.
gangfight	1 if self-reported gang fights. 0 otherwise.
fistfight	1 if self-reported fist fights. 0 otherwise.
beatup2	1 if self-reported beating up somebody for no reason. 0 otherwise.
throw	1 if self-reported throwing rocks or objects. 0 otherwise.
weapon	1 if self-reported carrying a weapon. 0 otherwise.
shoplift	1 if self-reported stealing from store. 0 otherwise.
stealmoney	1 if self-reported stealing money. 0 otherwise.
steal100	1 if self-reported stealing more than \$100. 0 otherwise.
stealbike	1 if self-reported stealing a bicycle. 0 otherwise.
enterw/opay	1 if self-reported enter somewhere without paying. 0 otherwise.
breakenter	1 if self-reported break enter. 0 otherwise.
stolengood	1 if self-reported bought and used stolen goods. 0 otherwise.
thingw/oright	1 if self-reported having something that has no right to have. 0 otherwise.
familything	1 if self-reported destroying family things. 0 otherwise.
antenna	1 if self-reported destroying car antenna. 0 otherwise.
setfire	1 if self-reported setting fire. 0 otherwise.
drinkbeer	1 if self-reported drinking beer. 0 otherwise.
getdrunk	1 if self-reported getting drunk. 0 otherwise.
marijuana	1 if self-reported smoking marijuana. 0 otherwise.
school	1 if still in school at the age of 17. 0 otherwise.
2parent	1 if subject lived with both biological parents. 0 otherwise.
church	1 if subject went to church at least once a year. 0 otherwise.

friend	1 if subject's best friend was arrested by police. 0 otherwise.
adult	1 if subject knew any adults who are criminals. 0 otherwise.
bro/sis	1 if subject had brother(s) and/or sister(s) who were arrested. 0 otherwise.
workexp	1 if subject had some work experience between the age of 14 and 16. 0 otherwise.
pmoney	a 1 to 10 scale indicating the amount of pocket money.
Laval	1 if living in the economic region of Laval. 0 otherwise.
Lanaudière	1 if living in the economic region of Lanaudière. 0 otherwise.
Les Laurentides	1 if living in the economic region of Les Laurentides. 0 otherwise.
Montréal	1 if living in the economic region of Montréal. 0 otherwise.
otherarea	1 if not living in the economic region of Montréal, Laval, Lanaudière, Les Laurentides, or Montréal. 0 otherwise.
urate	annual average unemployment rate for people over the age of 15 of the economic region an individual lives in.
policeexp	per capita police expenditure of the city an individual lives in.

TABLE 6.2
SUMMARY STATISTICS OF VARIABLES

Variables	Mean	Value of dummy variables	Frequency
ojd	0.1174	0	579
		1	77
beatup1	0.1067	0	586
		1	70
strongarm	0.0762	0	560
		1	70
gangfight	0.1463	0	560
		1	96
fistfight	0.2713	0	478
		1	178
beatup2	0.032	0	635
		1	21
throw	0.0366	0	632
		1	24
weapon	0.2607	0	485
		1	171
shoplift	0.2012	0	524
		1	132
stealmoney	0.1372	0	566
		1	90
steal100	0.0747	0	607
		1	49
stealbike	0.0869	0	599
		1	57
enterw/opay	0.2088	0	519
		1	137

breakenter	0.09	0	597
		1	59
stolengood	0.2058	0	521
		1	135
thingw/oright	0.2378	0	500
		1	156
familything	0.0854	0	600
		1	56
setfire	0.029	0	637
		1	19
antenna	0.09	0	597
		1	59
drinkbeer	0.8567	0	94
		1	562
getdrunk	0.686	0	206
		1	450
marijuana	0.5137	0	319
		1	337
school	0.9375	0	41
		1	615
2parent	0.5503	0	295
		1	361
church	0.5442	0	299
		1	357
friend	0.343	0	431
		1	225
adult	0.4055	0	390
		1	266

bro/sis	0.1357	0	567
		1	89
workexp	0.5488	0	296
		1	360
pmoney	3.8887	scale 1 to 10	NA
Laval	0.0366	0	632
		1	24
Lanaudière	0.0916	0	596
		1	60
Les Laurentides	0.0518	0	622
		1	34
Montréal	0.096	0	593
		1	63
otherarea	0.0321	0	203
		1	21
urate	12.66	NA	NA
policeexp	186.125	NA	NA

(1) Delinquency measures

Two types of delinquency measures are provided in the data: self-reported delinquency behavioural items and official delinquency records from the police. The data have 27 self-reported delinquency variables consisting of such items as: (1) beating up somebody to force them to do something, (2) using strong arm tactics in a fight, (3) participating in a gang fight, (4) fist fight, (5) beating up somebody for no reason, (6) throwing rocks or objects, (7) carrying a weapon, (8) stealing \$10 or more, (9)

stealing from store, (10) stealing \$100 or more, (11) entering somewhere without paying, (12) stealing between \$10 and \$100, (13) stealing money, (14) stealing less than \$10, (15) stealing a bicycle, (16) buying and using stolen goods, (17) breaking and entering, (18) having something that one has no right to have, (19) destroying musical instruments, (20) destroying things not yours, (21) destroying something at school, (22) destroying family things, (23) destroying car antenna, (24) setting fires, (25) drinking beer, (26) getting drunk, (27) smoking marijuana.

According to the *Tremeeer's Criminal Code* (2000) followed by the Canadian police⁵⁹, all the 27 self-reported delinquent items, though some of them may appear minor, can be chargeable criminal or status offences⁶⁰. For example, items (1) to (6) can be classified as "assault" under section 265⁶¹. Items (8) to (16) can be classified as "theft" under section 322 of the criminal code. Items (25) "drinkbeer" and (26) "getdrunk" can be classified as status offences of children and youth. Interestingly, these two status offences have higher self-reported rates than do other forms of delinquency. Other items included in the list can also be classified as assaults and/or thefts. The 27 items were also scored on a scale of 1 to 4 (1= never, 2 = once or twice, 3 = many times, and 4 = frequently).

⁵⁹I am thankful to the information and interpretation of the Canadian Criminal Code provided by Sr/Const. Kenneth Williams of the Ottawa-Carleton Police.

⁶⁰For more applications of the Canadian Criminal Code, see Barnhorst and Barnhorst (1996).

⁶¹See Appendix 6B for the interpretation of the criminal code in relation to the self-reported delinquency items used in this study.

Except for “drinking beer,” “getting drunk,” and “smoking marijuana.”⁶² very few individuals chose “3” (often) or “4” (very often) as their answer. Since the occurrence of “3” and “4” are very infrequent, I recoded the 27 self-reported delinquency items as 0-1 dummy variables (0=never, 1=once or more).⁶³

For most of the 27 questions, a non-response rate of about 25% of the 1047 individuals was found. Four of the items, “stealing \$10 or more,” “destroying musical instrument,” “destroying things not yours,” and “destroying something at school” elicited an exceptionally higher proportion of response failure (about 35%). In addition, less than 5% of the individuals reported having committed one of these acts, that is, gave a response of either “2,” “3,” or “4” in the survey on any three of these four items, except for “destroying things not yours”. Because their inclusion would have constituted to a loss of about an additional 100 observations from the sample and because the non-response would seem to indicate too minor an involvement to merit serious attention, these four items were dropped from the list of items indicating delinquent behaviour. Similarly, because the definition of “stealing money” overlaps with “stealing less than \$10,” and “stealing \$10 to

⁶²Less than 2% of the individuals chose “3” or “4” for 13 of the 27 items and less than 5% chose “3” or “4” on the rest except for “drink beer,” “getting drunk,” and “smoke marijuana.”

⁶³An alternative coding method was attempted to distinguish frequent offenders. Each of the 27 items was coded as 1 if an individual responded to a question by choosing “3” and “4” (often and very often), and 0 if an individual responded to a question by choosing “1” or “2”. This alternative coding system leads to the result where none of the self-reported delinquent behaviour has significant relationship with “ojd,” except for “strongarm”. The coefficients and marginal effects of the social characteristics become slightly more significant under this alternative coding system.

\$100,” only “stealing money” will be retained in the following analysis. Finally, the official delinquent records measure cumulative convictions through the age of 17 in 1995. Annual data on official convictions is not available.

The theory suggests that if law enforcement is effective and individuals are honest in reporting their own delinquency, the self-reported delinquent items will be reasonably good predictors of the acquisition of an official delinquent record. To the extent that law enforcement is costly, the police and court may use other social characteristics/backgrounds of an individual to assist in crime investigation and conviction.

(2) Individual Social Characteristics

According to the theory of statistical discrimination, the police and the court practice statistical discrimination if they overuse various social characteristics of individuals in their criminal investigation and conviction. Presumably, the police and the court would use the most obvious characteristics such as race, sex, and age, to minimize investigation effort and expenses associated with conviction. In our case, however, the design of the Montréal Longitudinal Study has created a homogenous population that consists of only Francophone white males of the same age. Hence there is no variation within the sample in terms of race, sex, and age. Police and court may still utilize other social characteristics. Police who have the initial contact with suspects may tend to rely on the more obvious social characteristics. For example, the police may expect that students are less likely to be delinquent, but youths who are seen to be associated with other delinquents and criminals are more likely to commit crime. On the other hand, the court may invest time and effort to find out more about the background of a charged youth

through social workers and other legal professionals. Furthermore, current delinquents and associates of delinquents are considered a “low-cost” group for the police to search. When deciding whether to convict an adolescent, the court may consider individual social background such as whether the individual lives with both parents, attends church services and has some work experience.

The Montréal study provides a number of different measures of behaviour associated with school attendance and performance. For example, the grades received in Mathematics and French can be used to measure performance at school. Similarly, frequency of school days missed and whether classes were skipped can be used to measure school attendance. The intention of pursuing further study can also be used to measure the attitude towards school. However, the most easily observed behaviour is perhaps whether an adolescent is a student or not. Given that the police aim to minimize search costs, the student status of an adolescent may be a good social indicator used by the police and court. About 94% of sample population was still in school at the age of 17 in 1995.

Family is believed to have an influence on an adolescent’s behaviour. One debate in the psychology literature concerns the differences between “family structure” and “family attachment.”⁶⁴ Family structure refers to the living arrangements which an adolescent experiences. Family attachment, on the other hand, refers to the relationship of an adolescent with the other family members. If the family is an effective source of informal control of delinquency, then the fact that parents know where their children are

⁶⁴See Chapter 4 for a discussion of the differences between family structure and family attachment.

can reduce the probability of being a delinquent. Going out with one's family on a regular basis is also an indication that an adolescent has close ties with his family. However, the level of family attachment is difficult to observe, and the costs of detecting such information are much higher than finding out whether an adolescent lives with both biological parents or not. To minimize expenses, family structure is less costly for the court to use as a social indicator than other family attachment behaviour. Slightly more than half of the sample population were living with both biological parents at the age of 17 in 1995.

Religion is another form of social influence that is believed to affect the behaviour of an adolescent. Church, for example, can provide sermons that serve to control delinquency. Although church attendance may not be easily observed by police during arrest, status as a "church youth" may be better revealed to the court at the stage of conviction, and the court may expect that a "church youth" is less likely to commit another offence. About half of the sample population reported going to church at least once in 1995 at the age of 17.

An adolescent who is known to have other delinquent associates is more likely to be a crime suspect as a way for the police to minimize search cost since police and court have records of names and addresses of delinquent youths. This may also reflect the result that delinquency tends to be committed in groups (Jensen and Rojek, 1992). When deciding whether to charge and convict an adolescent, the police and court may also try to detect whether the person has any delinquent brother(s) and/or sister(s) and/or other adult criminal associates. At the age of 17 in 1995, about 34% of our sample population

reported having their best friend arrested by police. about 41% reported knowing some adult who was a criminal, and about 14% reported having at least a brother and/or sister who was arrested in 1995.

Work experience may also be used by the court in assessing the probability of conviction. For example, the court may expect employed youths who are still in school to be less likely than their unemployed counterparts to become fully delinquent. Although work experience may not make a good social indicator for young adolescents, it may well be used by the court for older adolescents. About 55% of our sample population reported having some kind of work experience between the ages of 14 and 16.

(3) Regional Characteristics

Individual residential information is provided by postal codes. Individuals can therefore be identified by the cities/economic regions in which they resided.⁶⁵ This information is used to match individuals with information on regional unemployment rates⁶⁶ and police enforcement expenditures.⁶⁷ These two variables indicate the structural

⁶⁵This was done by using the postal code check of the Canada Post's website (www.canadapost.ca). Postal code information of 1995 is not available unfortunately. The analysis therefore is based on postal code information from 1994 assuming that individuals had not moved between 1994 and 1995.

⁶⁶Information on annual unemployment rate of economic regions in Quebec are obtained from CANSIM (matrix 3487: D988487 to D988501 and D968839). Residential information from postal codes are then matched with data on unemployment rate of the respective economic region by using *Répertoire des municipalités Du Québec 2000* (section 3.3.4: region administrative, p.91-106) to obtain a measure of unemployment rate.

⁶⁷The postal information is also used to match with data on per capita police expenditure published by Statistics Canada (Statistics Canada 85F00116XPB) to obtain a measure of

characteristics of the different areas in Quebec. For instance, unemployment rates show the general economic condition in the different regions. To use one example, Gaspésie-Iles-de-la-Madeleine has an exceptionally high unemployment rate over the years 1991 to 1995. Per capita police expenditures indicate the relative effort made to fight crime in different cities. Here the city of Montréal has the highest per capita expenditure on police activities in 1995. The postal information shows that about 70% of the individuals in our sample reside in the economic regions of Montréal; the rest are concentrated in Laval, Lanaudière, Les Laurentides, and Montérégie.

Empirics

The empirical model tests the theory of statistical discrimination presented in the last section. The official delinquency record is the dependent variable and is assumed to be affected by two groups of factors, namely self-reported delinquent behaviour and social characteristics. Let ojd^* be the number of official delinquent records acquired such that

$$(3) \quad ojd^* = ojd^*(q, z)$$

where q is a vector of self-reported delinquent behaviour, and z is a vector of social characteristics.

police expenditure.

Since the actual number of official delinquent records are not available for this study, ojd^* is the latent variable related to whether an individual had acquired an official record between the age of 10 and 17 (ojd), a relationship which is deemed necessary for the logit analysis in the following discussion. ojd^* is an unobservable continuous variable upon which the observable variable ojd depends in the following manner:

$$(6.5) \quad ojd = \begin{cases} 1 & \text{if } ojd^* > 0 \\ 0 & \text{if } ojd^* \leq 0 \end{cases}$$

The logit model will be estimated by maximizing the log-likelihood function that follows,

$$(6.6) \quad \ln L = \sum \left[ojd_i \ln \left[\frac{\exp(BX)}{1 + \exp(BX)} \right] + (1 - ojd_i) \ln \left[\frac{1}{1 + \exp(BX)} \right] \right],$$

where

$$(6.7) \quad BX = \beta_0 + \sum \beta_{mi} a_{mi} + \sum \beta_n z_n$$

where β 's are the respective coefficients of the explanatory variables. β 's in the logit model measure the marginal effects on the log-odds. For example, β_m indicates how the log-odds in favor of being a delinquent change when a_m is changed by a unit.

Table 6.3 shows the effects of self-reported delinquency, individual social characteristics, and regional characteristics on the probability of acquiring an official delinquency record. Since the dependent variable, official delinquency record ("ojd") is a cumulative measure of whether the individual had acquired an official conviction between the ages of 10 and 17, it would be ideal to have the explanatory variables to cover the entire time period. However, information is available for only some of the variables in the analysis. There is, for example, no record of whether any individual in the sample dropped out of school before the age of 15. There is also no record of whether there was any work for a salary before the age of 14. Perhaps more importantly, information about the association with other delinquent peers, brother(s), sister(s) and/or adult criminal is not available until the age of 14 and postal code information is only available for the years when the individuals were between 14 and 16. For our test, then, all the explanatory variables are from the year 1995, except for "workexp." Tables 6.3A and 6.3B show a first set of regressions where regional dummies are used to capture regional differences. Table 6.3A reports the coefficients of the explanatory variables (with the corresponding t-statistics in parentheses), and Table 6.3B reports the marginal effects of the explanatory variables.

(1) Goodness of fit

The model's overall goodness of fit is indicated by the McFadden R-square and Count R-square in Table 6.3A. Model 1 shows the results when only the self-reported delinquency items are used as explanatory variables; model 2 shows the results when only

the social and regional characteristics are used as explanatory variables; and model 3 includes all the factors as explanatory variables. Due to the differences in the number of explanatory variables used, the different R-square measures and the value of the log-likelihood functions are not directly comparable between the different model specifications. The results indicate that, however, while model 2 has fewer explanatory variables than model 1, the McFadden R-square is about 10% higher in the case of model 2 than model 1. This implies that the social and regional characteristics provide a better explanation for the acquisition of official delinquency record than self-reported delinquency. However, the McFadden R-square of model 3 is still more than 7% higher than that of model (2), suggesting that self-reported delinquent behaviour may still provide some additional explanatory power in the determination of acquiring an official record. This implication can also be shown by the fact that the coefficients of most social characteristic variables slightly drop in significance going from model (2) to model (3). Performing the Wald Chi-square on the coefficients of the self-reported delinquent behaviour of model (3) yield a value of 30.17, which is significant at the 10% level, suggesting that the self-reported delinquent items may have some joint significance in the determination of the probability of acquiring an official delinquent record.

TABLE 6.3A
COEFFICIENTS AND T-STATISTICS OF FACTORS AFFECTING
OFFICIAL DELINQUENCY RECORDS:
REPRESENTATION OF REGIONAL CHARACTERISTICS BY REGIONAL
DUMMIES⁶⁸

	Independent variables	model 1	model 2	model 3
Self-reported Delinquency	beatup1	0.4335 (1.11)	-----	0.7554** (1.68)
	strongarm	0.2983 (0.62)	-----	0.0642 (0.11)
	gangfight	-0.1361 (-0.33)	-----	-0.3207 (-0.66)
	fistfight	0.7262*** (2.15)	-----	0.6384** (1.66)
	beatup2	0.2264 (0.38)	-----	-0.1576 (-0.23)
	throw	-0.7144 (-1.07)	-----	-1.0139 (-1.30)
	weapon	0.7252*** (2.22)	-----	0.6917** (1.82)
	shoplift	0.2093 (0.61)	-----	0.4330 (1.05)
	stealmoney	-0.1289 (-0.33)	-----	0.0281 (0.06)
	steal100	0.6589* (1.30)	-----	0.2944 (0.51)
	stealbike	0.7039** (1.66)	-----	0.1530 (0.30)
	enterw/opay	-0.1283 (-0.36)	-----	0.0494 (0.12)
	breakenter	0.6529* (1.40)	-----	0.9712** (1.84)

⁶⁸Other regional characteristics such as unemployment rate and police expenditure are not included with the regional dummies in the same analysis since there exists multicollinearity between these variables. See Appendix 6C for a discussion of multicollinearity of the models.

	stolengood	-0.0431 (-0.12)	-----	-0.2346 (-0.57)
	thingw/oright	-0.4396 (-1.21)	-----	-0.9584 (-2.22)
	familything	0.6570* (1.50)	-----	0.6264 (1.16)
	antenna	-0.0209 (-0.05)	-----	0.0514 (0.11)
	setfire	-1.8514 (-2.21)	-----	-1.5354 (-1.33)
	drinkbeer	0.1435 (0.25)	-----	0.5790 (0.89)
	getdrunk	0.0984 (0.24)	-----	-0.0010 (-0.02)
	marijuana	0.5133* (1.56)	-----	0.0989 (0.27)
Social Characteristics	school	-----	-1.6831*** (-4.15)	-1.8325*** (-3.92)
	2parent	-----	-1.0810*** (-3.54)	-1.1014*** (-3.35)
	church	-----	-0.4180* (-1.43)	-0.3254 (-1.01)
	friend	-----	1.4550*** (4.65)	1.2448*** (3.57)
	adult	-----	0.8132*** (2.60)	0.6683*** (1.99)
	bro/sis	-----	0.0953 (0.27)	-0.0066 (-0.02)
	workexp	-----	-0.5721*** (-1.97)	-0.8658*** (-2.66)
	pmoney	-----	0.0051 (0.07)	-0.0235 (-0.30)
Regional Characteristics	Laval	-----	-0.8134 (-0.72)	-1.0655 (-0.93)
	Lanaudière	-----	-0.3905 (-0.67)	-0.2495 (-0.38)
	Les Laurentides	-----	1.0449** (1.95)	1.4526*** (2.48)

	Montérégie	-----	0.1274 (0.28)	0.1009 (0.20)
	otherarea	-----	-0.1381 (-0.17)	-0.6976 (-0.72)
Value of log likelihood function		-199.19	-176.23	-158.75
LR statistics		76.13	119.55	157.01
McFadden R-square		0.1604	0.2572	0.3309
Count R-square		0.8242	0.8424	0.8594
Observations		656	656	656

*significant at the 10% level

**significant at the 5% level

***significant at the 1% level

The likelihood ratio tests for all model specifications give significant results, leading to the rejection of the null hypothesis that all slope coefficients are equal to zero. Judging from the different measures, the model can be considered to have a reasonable overall goodness of fit.

TABLE 6.3B
MARGINAL EFFECTS OF FACTORS AFFECTING
OFFICIAL DELINQUENCY RECORDS:
REPRESENTATION OF REGIONAL CHARACTERISTICS BY REGIONAL
DUMMIES

	Independent variables	model 1	model 2	model 3
Self-reported Delinquency	beatup1	0.0342	-----	0.0368**
	strongarm	0.0235	-----	0.0032
	gangfight	-0.0107	-----	-0.1563
	fistfight	0.0572***	-----	0.0312**
	beatup2	0.0178	-----	0.0077
	throw	-0.0563	-----	-0.0494
	weapon	0.0571***	-----	0.0337**
	shoplift	0.0165	-----	0.0211
	stealmoney	-0.0102	-----	0.0014
	steal100	0.0519*	-----	0.0143
	stealbike	0.0555**	-----	0.0075
	enterv/opay	-0.0101	-----	0.0024
	brekenter	0.0514*	-----	0.0473**
	stolengood	-0.0034	-----	-0.0114
	thingw/oright	-0.0346	-----	-0.0467
	familything	0.0518*	-----	0.0305
	antenna	-0.0016	-----	0.0025
	setfire	-0.1459	-----	-0.0748
	drinkbeer	0.0113	-----	0.0282
	getdrunk	0.0078	-----	-0.0005
	marijuana	0.0404*	-----	0.0048

Social Characteristics	school	-----	-0.3159***	-0.0893***
	2parent	-----	-0.0847***	-0.0537***
	church	-----	-0.0272*	-0.0159
	friend	-----	0.1305***	0.0607***
	adult	-----	0.0732***	0.0326***
	bro/sis	-----	0.0017	-0.0003
	workexp	-----	-0.0491***	-0.0422***
	pmoney	-----	0.0041	-0.0519
Regional Characteristics	Laval	-----	-0.0474	-0.0122
	Lanaudière	-----	-0.0228	0.0218
	Les Laurentides	-----	0.0609**	0.0778***
	Montréal	-----	0.0074	0.0049
	otherarea	-----	-0.0081	-0.034

*significant at the 10% level

**significant at the 5% level

***significant at the 1% level

(2) Self-reported delinquent behaviour

Judging from the results provided in Tables 6.3A and 6.3B, self-reported delinquent behaviour is far from perfect as a measure of the probability of acquiring an official delinquent record. From the results of model 1, only 7 of the 21 self-reported delinquent items ("fistfight," "weapon," "steal100," "stealbike," "breakenter," "familything," "marijuana.") are shown to have a significant positive effect on the acquisition of an official delinquent record." In addition, "setfire" has an unexpectedly significant negative impact on the acquisition of an official record as do two other self-

reported delinquent items (“throw” and “thingw/oright”). Hence, not only are the coefficients and marginal effects of more than half of the self-reported items are insignificant, but some of the signs of the coefficients and marginal effects are also inconsistent with the theoretical predictions. For example, results from the marginal effects of model 3 imply that the probability of acquiring an official record decreases by about 7% for individual who reported themselves for setting a fire. In short, the correlation between acquisition of an official delinquent record and self-reported delinquent behaviour appears to be weak in general from this analysis. This leads to the question that what other factors can affect the probability of getting convicted if actual delinquent behaviour can only offer limited explanations.

(3) Social characteristics

According to the theory of statistical discrimination, police and court may attempt to minimize expenses by focusing investigation and conviction efforts on people with certain characteristics, especially the more obvious characteristics such as race, sex, and age. Due to the homogenous population used in this study, these obvious characteristics cannot be applied. However, the database can reveal other dimensions that can be used by the police and the court in making arrest and conviction decisions. These other individual social characteristics are used to examine the theory of statistical discrimination.

It is relatively easy for the police to find out whether a teenager is a student or a high school dropout. The police may expect that high school dropouts are at a higher risk to commit crime. Tables 6.3A and 6.3B show that being in school significantly decreases the probability of an adolescent acquiring an official delinquency record by about 9%

(model 3 of Table 6.3B), implying that the student status can be a form of discriminatory practice used by police.

Adolescents who came from families that are intact are significantly less likely to acquire an official delinquent record. This implies that individuals who came from single-parent families are either more likely to be investigated by police or less likely to be treated leniently by the court. The court may expect that adolescents who live with both biological parents are at lower risk of committing further offences and therefore focus conviction efforts on those who do not live with both parents. The marginal effects from Table 6.3B show that the probability of acquiring an official record decreases by about 5 % for an adolescent who lived with both biological parents.

Religion and church attendance are sometimes thought to have a positive influence on people. The court may expect that adolescents who go to church are at a lower risk of offending in the future. According to the results of Tables 6.3A and 6.3B, individuals who attend church services at least once a year are not significantly less likely to acquire an official delinquent record, although the general direction of the relationship is shown to be negative. This may be due to the fact that it is relatively more difficult for the court to detect whether an individual goes to church than to detect whether the same individual is a student or comes from an intact family. Church attendance may be less obvious as a social characteristic and search costs of obtaining reliable information on such thing as church attendance may be relatively high. The regression results, however, still are consistent with the view that church attendance may be another social characteristic used in court decision.

To minimize search cost, the police may start the investigation of a crime by interrogating friends of delinquents. Similarly, adolescents who have delinquent/criminal brother(s) and/or sister(s) and/or any other adult criminal associates may also be treated in similar manner. The results from Tables 6.3A and 6.3B show that the probability of acquiring an official delinquent record significantly increases by about 6% if an adolescent self reports that his best friend is a delinquent⁶⁹ (model 3 of Table 6.3B). This may reflect the practice of the police to concentrate initial investigation efforts on friends of delinquents. Association with adult criminals is also shown to have significant effect on acquiring an official delinquent record. Knowing of at least one criminal adult increases the probability of acquiring an official delinquent record by about 3%. Having a delinquent brother or sister is shown to have no significant effect in increasing the probability of acquiring an official record.

Work experience is shown to be significant in decreasing the probability of acquiring an official delinquent record. Results from Table 6.3B show that the probability of acquiring an official delinquent record decreases by about 4% for adolescents who had some work experience any time between the age of 14 and 16. One possible explanation is that work experience may be another indicator used by the police and the court to discriminate. Another possible reason is that individuals who have jobs can be better at

⁶⁹It is also detected that adolescents who have delinquent friends are more likely to acquire an official delinquent record. However, the coefficients for both delinquent friend and delinquent best friend decrease when both are included in the same regression due to multicollinearity. For the purpose of showing the arguments, regressions with only delinquent best friend are shown here.

avoiding police detection. For example, skills that are useful in the workplace such as alertness, concentration, and time management can also be useful in successfully avoiding police detection and conviction.

An important implication from the findings on social characteristics is that social factors reduce official delinquency in two distinct ways. The first is by reducing the probability of delinquent behaviour, the second is by reducing the probability of acquiring an official record controlling for level of delinquent activity. For example, the results from Table 6.3B show that staying in school can reduce the probability of acquiring an official record by more than 30% when the level of self-reported delinquency is not taken into account. However, the probability of getting convicted only reduces by 9% for students once controlling for the level of self-reported delinquent behaviour. This implies that although the police and the court are likely to practice statistical discrimination using an individual's student status as a signal, school itself is likely to play a role in controlling delinquency directly to a certain extent. This kind of evidence can also be detected for other social characteristics. It is therefore important to control for the level of self-reported delinquency before analyzing the effect of various social factors on the probability of getting convicted.

(4) Regional Characteristics

Quebec is divided into 17 economic regions according to the classification by Statistics Canada. Regional dummies were created for the economic regions that the sample population concentrates in, except for Montréal which is used as the base case.

Results from Tables 6.3A and 6.3B show that individuals residing in the economic regions of Laval, Lanaudière, and Montérégie were neither more or less delinquent. The probability of acquiring an official record, however, significantly increases by 10% for adolescents living in the economic region of Les Laurentides.

The geographic information was also used to match individuals with both regional unemployment rates and per capita police expenditures. The results are shown in Table 6.4. Both unemployment rate and police expenditure have no significant impact on the probability of acquiring an official delinquent record. The results for the self-reported delinquency and social characteristic variables remain largely the same as before ⁷⁰

⁷⁰ The variable “shoplift” now has a significant impact on the probability of acquiring an official delinquent record.

TABLE 6.4
FACTORS AFFECTING OFFICIAL DELINQUENCY RECORDS:
REPRESENTATION OF REGIONAL CHARACTERISTICS BY UNEMPLOYMENT
RATE AND POLICE EXPENDITURE

categories of variables	Independent variables	model 1		model 2	
		coefficient	marginal effect	coefficient	marginal effect
Self-reported Delinquency	beatup1	0.8748*** (2.00)	0.0452***	0.8840*** (2.02)	0.0453***
	strongarm	0.1051 (0.18)	0.0054	0.1003 (0.18)	0.0051
	gangfight	-0.3070 (-0.64)	-0.0159	-0.3244 (-0.68)	-0.0166
	fistfight	0.5995* (1.60)	0.0031*	0.6113** (1.64)	0.0314**
	beatup2	-0.2050 (-0.30)	-0.0106	-0.2303 (-0.33)	-0.0118
	throw	-0.7407 (-0.99)	-0.0382	-0.7106 (-0.95)	-0.0365
	weapon	0.6838** (1.85)	0.0035**	0.6706** (1.81)	0.0344**
	shoplift	0.5271* (1.31)	0.0272*	0.5262* (1.31)	0.0270*
	stealmoney	-0.0208 (-0.05)	-0.0011	-0.0177 (-0.04)	-0.001
	steal100	0.2131 (0.37)	0.011	0.2132 (0.38)	0.0109
	stealbike	0.2064 (0.42)	0.0107	0.2046 (0.42)	0.0105
	enterw/opay	-0.1163 (-0.29)	-0.006	-0.1172 (-0.290)	-0.006
	breakenter	0.8092* (1.59)	0.0418*	0.8283* (1.62)	0.0425*
	stolengood	-0.2401 (-0.59)	-0.0124	-0.2246 (-0.56)	-0.0115
	thingw/oright	-0.7805** (-1.89)	-0.0403	-0.8056 (-1.94)	-0.0413
	familything	0.5400 (1.02)	0.0279	0.5287 (1.00)	0.0271

	antenna	-0.0637 (-0.13)	-0.0033	-0.0674 (-0.14)	-0.0035
	setfire	-1.4331* (-1.30)	-0.074	-1.4296 (-1.30)	-0.0733
	drinkbeer	0.4337 (0.67)	0.0224	0.4346 (0.6761)	0.223
	getdrunk	0.0219 (0.05)	0.0011	0.0313 (0.07)	0.0016
	marijuana	0.1133 (0.31)	0.0059	0.1188 (0.33)	0.0061
Social Characteristics	school	-1.6729*** (-3.72)	-0.0864***	-1.6766*** (-3.73)	-0.0860***
	2parent	-1.0848*** (-3.35)	-0.0560***	-1.0892*** (-3.35)	-0.0559***
	church	-0.2961 (-0.94)	-0.0153	-0.2937 (-0.93)	-0.0151
	friend	1.2089*** (3.55)	0.0624***	1.2004*** (3.53)	0.0616***
	adult	0.7015*** (2.13)	0.0362***	0.7104*** (2.15)	0.0364***
	bro/sis	0.0349 (0.09)	0.0018	0.0404 (0.10)	0.0021
	workexp	-0.8430*** (-2.65)	-0.0435***	-0.8467*** (-2.66)	-0.0434***
	pinoney	-0.0014 (-0.02)	-0.0001	-0.0034 (-0.04)	-0.0002
Regional Characteristics	urate	0.0284 (0.31)	0.0015	-----	-----
	policeexp	-----	-----	0.0024 (0.75)	0.0001
Value of log likelihood function		-162.4		-162.16	
LR statistics		149.71		150.18	
McFadden R-square		0.3155		0.3165	
Count R-square		0.8571		0.8574	
Observations		656		656	

*significant at the 10% level **significant at the 5% level ***significant at the 1% level

(4) Comments

The general implication from the results of Table 6.3A and 6.3B is that social characteristics of an individual appear to be important in explaining juvenile delinquent behaviour. By comparison, social characteristics of individuals appear to explain official records much better than self-reported delinquency and regional characteristics. Student status, living with both biological parents, absence of delinquent peers, and past work experience are all shown to be important in reducing the probability of acquiring an official delinquent record. The findings are compatible with the theory of statistical discrimination.

One concern about the results presented in this study is that some of the self-reported delinquency behaviour examined here such as “stealmoney,” “fistfight,” and “throw” may be considered minor and are not likely to lead to arrests and convictions. Other more serious offences such as homicides and rapes are more likely to lead to the acquisition of an official record. Such information, however, is generally not available from self-report surveys such as the one used here. Even if this kind of information were available, the sample size for individuals who commit serious offences are usually too small for any meaningful analyses.

It was mentioned earlier that all the self-reported delinquency items, however minor, can still be classified as punishable criminal offences under the Canadian Criminal Code. Furthermore, the results from this study shows that potentially serious offences such as carrying a weapon in fights (“weapon”) and break and enter (“breakenter”) are not insignificant in the determination of the acquisition of an official record.

A general criticism on survey studies such as our Montréal Longitudinal Study is that the self-reported delinquent behaviour can be unreliable. This is often called the problem of under-reporting and over-reporting. Measurement error, through such things as inaccurate reporting, decreases the precision with which the effect of self-reported delinquency on official delinquency can be measured. Moreover, systematic bias in the recording of self-reported behaviour can also affect the reported results.

The survey method used by the Montréal Longitudinal Study has attempted to minimize the size of potential measurement errors⁷¹ by cross-checking the information provided by the adolescents themselves, their parents and teachers whenever possible. Survey participants are also assured of individual anonymity. The names of individuals were never utilized by any researcher except for the purpose of matching records. By following such accepted survey methods, the questionnaires can be expected to generate unbiased and reasonably reliable answers from individuals. The data-base covers answers to 27 self-reported delinquency items collected from a questionnaire about school, family, friends, and leisure activities. The 27 items are also not explicitly indicated as questions about delinquent behaviour and are widely spread out in the questionnaire. Such carefully designed survey practices help to minimize moral hazard in self-reported answers.

6.3 Conclusion

This chapter examines whether the factors affecting the probability of acquiring an official delinquent record can differ from the frequency of actual delinquent acts committed

⁷¹For more detailed description of survey methods used in the Montréal Longitudinal Study, see Tremblay et al. (1994).

by the same individuals. A theoretical model is constructed using the theory of statistical discrimination. Three groups of factors can affect the probability of getting caught by police and convicted by the court. The first group of factors concern the actual delinquent acts committed by individuals and referred to as self-reported delinquent behaviour. The second group of factors involve individual background characteristics that may be used by police to reduce search costs of crime investigation and the court to evaluate the likelihood of future delinquency. This second group of factors is social indicators used by police and the court to practice statistical discrimination and are referred to as social characteristics. The third group of factors attributes different conviction rates to regional characteristics.

The theory suggests that if crime investigation by police is perfectly effective and the court has perfect foresight about future delinquency, then self-reported delinquent behaviour would be a perfect indicator of the probability to acquire an official record. This is not the case, however, when data from the Montréal Longitudinal Study are applied empirically. The results showed that many forms of self-reported delinquency do not appear to significantly affect the probability of getting an official record.

Individual background characteristics, on the other hand, appear to have better explanatory power on official delinquent record even after controlling the level of delinquent behaviour using self-reported delinquency. This suggests that various social characteristics may be used by police to reduce search costs and the court to minimize the expenses on conviction. The results of this study show that adolescents who are students, live with both biological parents, have some work experience, and have no delinquent friends are much less likely to acquire an official delinquent record. These results imply

that the police and the court use various social indicators and practices statistical discrimination in crime investigation and conviction.

APPENDIX 6A
ORIGINAL SURVEY QUESTIONS AND FREQUENCY DISTRIBUTION OF THE
SELF-REPORTED DELINQUENT VARIABLES

variable name	original survey question in French (frequency distribution in parentheses)
beatup1	<p>Au cours des 12 derniers mois, as-tu menacé de battre quelqu'un pour le forcer à faire quelque chose qu'il ne voulait pas faire?</p> <p>1 jamais (586) 2 une ou deux fois (57) 3 plusieurs fois (8) 4 très souvent (5)</p>
strongarm	<p>Au cours des 12 derniers mois, as-tu utilisé une arme en te battant?</p> <p>1 jamais (560) 2 une ou deux fois (64) 3 plusieurs fois (5) 4 très souvent (1)</p>
gangfight	<p>Au cours des 12 derniers mois, as-tu pris part à des batailles entre groupes de jeunes (gangs)?</p> <p>1 jamais (560) 2 une ou deux fois (90) 3 plusieurs fois (3) 4 très souvent (3)</p>
fistfight	<p>Au cours des 12 derniers mois, t'es-tu battu à coups de poing avec une autre personne?</p> <p>1 jamais (478) 2 une ou deux fois (151) 3 plusieurs fois (22) 4 très souvent (5)</p>
beatup2	<p>Au cours des 12 derniers mois, as-tu battu quelqu'un qui ne t'avait rien fait?</p> <p>1 jamais (635) 2 une ou deux fois (20) 3 plusieurs fois (0) 4 très souvent (1)</p>
throw	<p>Au cours des 12 derniers mois, as-tu utilisé une arme (bâton, couteau, fusil, roches...) en te battant avec une autre personne?</p> <p>1 jamais (632) 2 une ou deux fois (20) 3 plusieurs fois (4) 4 très souvent (0)</p>
weapon	<p>Au cours des 12 derniers mois, t'est-il arrivé de porter une arme (une chaîne, un couteau, fusil, etc...)?</p> <p>1 jamais (485) 2 une ou deux fois (102) 3 plusieurs fois (44) 4 très souvent (15)</p>

shoplift	<p>Au cours des 12 derniers mois, as-tu pris et gardé quelque chose sans payer dans un magasin?</p> <p>1 jamais (524)</p> <p>2 une ou deux fois (101)</p> <p>3 plusieurs fois (24)</p> <p>4 très souvent (7)</p>
stealmoney	<p>Au cours des 12 derniers mois, as-tu pris et gardé de l'argent à maison sans la permission et sans l'intention de le rapporter?</p> <p>1 jamais (566)</p> <p>2 une ou deux fois (73)</p> <p>3 plusieurs fois (15)</p> <p>4 très souvent (2)</p>
steal100	<p>Au cours des 12 derniers mois, as-tu pris et gardé quelque chose de 100\$ et plus qui ne t'appartenait pas?</p> <p>1 jamais (607)</p> <p>2 une ou deux fois (40)</p> <p>3 plusieurs fois (8)</p> <p>4 très souvent (1)</p>
stealbike	<p>Au cours des 12 derniers mois, as-tu pris et gardé une bicyclette qui ne t'appartenait pas?</p> <p>1 jamais (599)</p> <p>2 une ou deux fois (40)</p> <p>3 plusieurs fois (12)</p> <p>4 très souvent (5)</p>
enterw/opay	<p>Au cours des 12 derniers mois, es-tu entré sans payer dans un endroit payant (cinéma, spectacle, événement sportif)?</p> <p>1 jamais (519)</p> <p>2 une ou deux fois (120)</p> <p>3 plusieurs fois (14)</p> <p>4 très souvent (3)</p>
breakenter	<p>Au cours des 12 derniers mois, as-tu défoncé une porte ou une fenêtre et es-tu entré prendre part pour y prendre quelque chose?</p> <p>1 jamais (597)</p> <p>2 une ou deux fois (49)</p> <p>3 plusieurs fois (4)</p> <p>4 très souvent (6)</p>
stolengood	<p>Au cours des 12 derniers mois, as-tu acheté, utilisé ou vendu quelque chose que tu savais avoir été volé?</p> <p>1 jamais (521)</p> <p>2 une ou deux fois (107)</p> <p>3 plusieurs fois (22)</p> <p>4 très souvent (6)</p>

thingw/oright	<p>Au cours des 12 derniers mois, t'es-tu introduit quelque part où tu n'avais pas le droit (exemple: maison où il n'y a personne, hangars, voies ferrées, maisons en construction...)?</p> <p>1 jamais (500)</p> <p>2 une ou deux fois (123)</p> <p>3 plusieurs fois (30)</p> <p>4 très souvent (3)</p>
familything	<p>Au cours des 12 derniers mois, as-tu brisé ou détruit par exprès quelque chose qui appartenait à tes parents ou à un autre membre de ta famille?</p> <p>1 jamais (600)</p> <p>2 une ou deux fois (51)</p> <p>3 plusieurs fois (5)</p> <p>4 très souvent (0)</p>
antenna	<p>Au cours des 12 derniers mois, as-tu détruit par exprès, une antenne, des pneus ou d'autres parties d'une automobile?</p> <p>1 jamais (637)</p> <p>2 une ou deux fois (15)</p> <p>3 plusieurs fois (2)</p> <p>4 très souvent (2)</p>
setfire	<p>Au cours des 12 derniers mois, as-tu mis le feu par exprès, dans un magasin ou dans d'autres endroits?</p> <p>1 jamais (597)</p> <p>2 une ou deux fois (52)</p> <p>3 plusieurs fois (3)</p> <p>4 très souvent (4)</p>
drinkbeer	<p>Au cours des 12 derniers mois, as-tu pris une bouteille de bière, un verre de vin, un verre de boisson forte?</p> <p>1 jamais (94)</p> <p>2 une ou deux fois (147)</p> <p>3 plusieurs fois (249)</p> <p>4 très souvent (166)</p>
getdrunk	<p>Au cours des 12 derniers mois, t'es-tu soûlé avec de la bière du vin ou d'autres boissons fortes?</p> <p>1 jamais (206)</p> <p>2 une ou deux fois (186)</p> <p>3 plusieurs fois (182)</p> <p>4 très souvent (82)</p>
marijuana	<p>Au cours des 12 derniers mois, as-tu pris de la marijuana ou du hachisch (un joint, du pot)?</p> <p>1 jamais (319)</p> <p>2 une ou deux fois (122)</p> <p>3 plusieurs fois (100)</p> <p>4 très souvent (115)</p>

APPENDIX 6B

INTERPRETATION OF CANADIAN CRIMINAL CODE IN RELATION TO SELF-REPORTED DELINQUENCY

The 27 self-reported delinquency items contained in the Montréal Longitudinal Study can all be classified as criminal offences under the Tremear's Criminal Code. The classification by the Criminal Code of the first 10 self-reported delinquency items used in this study are provided as follows:

"shoplift," "stealmoney," "steal 100," and "steal bike" "enterw/opay," "breakenter," "stolengood," thingw/oright," "familything," antenna" can all be classified as "theft" under section 322 of the Criminal Code, "Theft—Everyone commits theft who fraudulently and without colour of right takes, or fraudulently and without colour of right converts to his use or to the use of another person, anything, whether animate or inanimate, with intent, (a) to deprive, temporarily or absolutely, the owner of it, or a person who has a special property or interest in it, of the thing or of his property or interest in it; (b) to pledge it or deposit it as security; (c) to part with it under a condition with respect to its return that the person who parts with it may be unable to perform; or (d) to deal with it in such a manner that it cannot be restored in the condition in which it was at the time it was taken or converted."

According to section 334 of the Criminal Code, punishment for theft is described as "except where otherwise provided by law, every one who commits theft (a) is guilty of an indictable offence and liable to imprisonment for a term not exceeding ten years, where the property stolen is a testamentary instrument or the value of what is stolen exceeds five thousand dollars; or (b) is guilty (i) of an indictable offence and is liable to imprisonment

for a term not exceeding two years, or (ii) of an offence punishable on summary conviction, where the value of what is stolen does not exceed five thousand dollars.” This implies that regardless of the value involved, any form of theft is punishable under the Canadian Criminal Code.

“breakenter” can obviously be classified as “breaking and entering” under section 348 cited as follows, “Every one who (a) breaks and enters a place with intent to commit an indictable offence therein, (b) breaks and enters a place and commits an indictable offence therein, or (c) breaks out of a place after (i) committing an indictable offence therein, or (ii) entering the place with intent to commit an indictable offence therein is guilty...”

“beatup1,” “beatup2,” “strongarm,” “gangfight,” “fistfight,” “weapon,” and “throw” can all be classified as “assault” under section 265. “A person commits an ‘assault’ when (a) without the consent of another person, he applies force intentionally to that other person, directly or indirectly; (b) he attempts or threatens, by an act or a gesture, to apply force to another person, if he has, or causes that other person to believe on reasonable grounds that he has, present ability to effect his purpose; or (c) while openly wearing or carrying a weapon or an imitation thereof, he accosts or impedes another person or begs.”

APPENDIX 6C
RELATIONSHIP BETWEEN EACH EXPLANATORY VARIABLE WITH OTHER
EXPLANATORY VARIABLES USING AUXILIARY R-SQUARE MEASURES
TESTS OF MULTICOLLINEARITY⁷²

	variables	auxiliary r-square
Self-reported Delinquency	beatup1	0.2464
	strongarm	0.4447
	gangfight	0.4437
	fistfight	0.3958
	beatup2	0.2079
	throw	0.2694
	weapon	0.3832
	shoplift	0.3469
	stealmoney	0.2338
	steal100	0.4677
	stealbike	0.3225
	enterw/opay	0.3056
	breakenter	0.4334
	stolengood	0.375
	thingw/oright	0.3395
	familything	0.2235
	antenna	0.3103
	setfire	0.2724
	drinkbeer	0.324
	getdrunk	0.4031
	marijuana	0.3197

⁷²Each of the variables is used as the dependent variable to run against all other variables listed in an OLS regression, except for "urate" and "policeexp." The regression that uses "urate" as the dependent variable excludes "policeexp" as an explanatory variable and vice versa. The regional dummies are not tested for multicollinearity since they are correlated with each other by construction.

Social Characteristics	school	0.1503
	2parent	0.0917
	church	0.1131
	friend	0.2611
	adult	0.2527
	bro/sis	0.0822
	workexp	0.0718
	pmoney	0.0851
Regional Characteristics	urate	0.0645
	policeexp	0.0575

As shown in the table, all the auxiliary R-square measures are below 0.5, implying that there does not exist serious multicollinearity between the explanatory variables.

Chapter 7

Conclusion

The goal of this dissertation has been to examine delinquent behaviour from an economic perspective. I began by formulating a theory where an individual maximizes utility subject to budget and time constraints. Each individual is assumed to allocate a fixed amount of time among delinquency, market work, school, and leisure. Three types of capital are assumed: crime-productive capital, work-productive capital, and school-productive capital. The capital accumulation process is assumed to have an impact on the optimal time use decisions among different activities of an individual. Individuals are also allowed to choose not to participate in one or more of the activities assumed in the model. Theoretical implications are provided for the effects of different social institutions on time spent on delinquency, school, and market work.

Data from the Montréal Longitudinal Study are then used to test the theory. Although the database contain a sample population that possess certain unique characteristics and therefore may not be generalized to behaviour of Canadian youth as a whole, the findings from this thesis still provide some important insights about the relationship between the level of delinquency and social institutions. Two measures of delinquency are provided, self-reported delinquency and the official delinquent record. Empirical estimations using self-reported delinquency as the dependent variable show that

social institutions such as school, family, church, peers, and market work are influence of delinquent behaviour to certain extents.

Throughout the analysis, the presence of a delinquent best friend and criminal adult associate(s) appear to be particularly influential in affecting an individual's level of delinquency. From a theoretical perspective, adolescents who have close contacts with other delinquents or criminals are more ready to accumulate crime-productive capital. These findings have important policy implications. To reduce the level of delinquency, not only do adolescents have to learn that criminal and delinquent behaviour are not acceptable social behaviour, but they must also stay away from other delinquents and criminals. Incarceration has the effect of putting delinquents together and letting them share their delinquent skills, further putting them at risk of becoming "chronic" delinquents. Such effects are further magnified when adolescents are put in prison with more skilled criminals. Recent policies to lower the age at which youth can be transferred to adult court and consequently make it easier to commit juveniles to adult prisons may therefore have significant negative consequences. It may also be worthwhile for social workers to focus their efforts on adolescents who have not acquired official delinquent records, but who hang around other delinquents or whose family members have become criminals.

Education is important for a young person to learn what is socially acceptable, and school plays a vital role. The analysis in this dissertation continues to show the important relationship between delinquency and various school-productive capital accumulation. For

example, past efforts made to go to school and to perform well in school have shown to be important in deterring delinquency. Not only is good performance in school a socially valuable asset, but it also helps to provide a positive self-identity (Garbarino, 1995 and 1999; Rumberger, 1987). This is particularly important for adolescents. This implies that the “zero tolerance” rule recently enacted by most schools in Canada may have important implications. On the one hand, the “zero tolerance” rule aims to eliminate children and youth with problematic behaviour from the school system. Many Canadian judges, for example, share the view that children and youth who begin with relatively minor form of delinquency in school end up in court with more serious forms of delinquency after they drop out of school (Landon, 2000). My thesis further confirms this finding by showing that adolescents who frequently miss school or drop out of school are more likely to be delinquent. On the other hand, the “zero tolerance” policy can minimize the delinquent influence on other children. Further research effort on the net impact of the “zero tolerance” policy on crime would be a useful extension of this research.

One important role of school is to educate people so that they become socially responsible citizens, and not to reject people who are already slipping off. Staying in school seems to have a vital role in keeping teenagers on track. Policies to discourage dropping out of high school are likely to be beneficial. From the findings in this dissertation, a positive attitude toward school encourage adolescents to stay in school and stay away from delinquent activities. Previous literature has further shown that smaller school and class size are effective means in retaining students (Coleman and Hoffer, 1987;

Ferris and West, 2000). It has been found that smaller school and class size can help to develop better teacher-student relationship so that teachers can expend more effort on students with various problems (Gabarino, 1995 and 1999; Natriello, 1994). Although discussion on the organizational features of the school system is beyond the scope of this dissertation, it is an important issue that requires continuing research efforts.

The analysis also shows that adolescents who live with both biological parents are less delinquent. A stable family structure may have different implications such as better child-parent relationship and closer supervision on children's behaviour. A traditional two-parent household may simply be more socially acceptable and aids the process of capital accumulation for an adolescent. The findings in the dissertation imply that family support is likely to help in the deterrence of delinquency. Therefore, it can be speculated that family and marriage counselling may possibly help to strengthen family relationship and therefore to control delinquency. Indeed, some judges and other advocates urge the family and juvenile courts to consider family re-union more often as solutions to minor forms of delinquency (Hubner and Wolfson, 1998). Another suggestion to keep families together is to make divorce more difficult by switching from no-fault divorce law to mutual divorce law (Allen, 1999). Further research and evidence are required to examine the effects of these policies.

Early market work experience appears to have a positive relationship with self-reported delinquent behaviour. Interpretations for these results can be quite complicated. These findings, however, are consistent with findings from previous literature that

teenagers may use market work as a “cover up” of their delinquent behaviour (Good and Pirog-Good, 1987). Adolescents who work at an early age can be more materialistic and are therefore likely to exhaust all possible sources of monetary gains from both market work and crime. Furthermore, adolescents who start working at an early age may be more likely to be distracted from study and school, and therefore make it more difficult to accumulate school-productive capital. With a lower level of school-productive capital, the theory suggests that time spent on delinquency will increase. The important policy implication is that recent advocates of the work co-op options for high school students may have mixed effects. On the one hand, market work may help adolescents to apply practically their learning from school. On the other hand, market work may also distract teenagers from school work. Policies and programs must be carefully designed to take into account such kind of tradeoff. Further research and evidence on the net impact of work co-ops on adolescent’s activity choice is required before any conclusion can be drawn. The negative relationship found between market work experience and official delinquent record may suggest that individuals who work are also better at avoiding police detection.

Certain people and organizations believe that religion should have positive effects on inducing moral compliance of youth, as was suggested by Phillips and Votey (1987b). The results obtained here lend some support to such beliefs. Although the negative relationship between church attendance and self-reported delinquency behaviour was found to be insignificant from the cross-sectional analysis, such negative relationship is

statistically significant from the panel data analysis. This implies that church is likely to have a stronger positive influence on younger than older adolescents. Church attendance, however, is only one measure of the religion factor. The extent to which a person practices or believes in his religion may yield different implications on his behaviour. Of course, such kind of information, even if made available, is highly subjective depending on individual interpretation.

The analysis using official delinquent record as the dependent variable reinforces the findings that the various capital variables have a significant relationship with the probability of acquiring an official record. This is even true after controlling for the level of self-reported delinquency. Many forms of self-reported delinquency, however, are shown to have no significant relationship with the probability of acquiring an official record. These findings lead to the conclusion that the police and court are suspected of practising statistical discrimination when making arrest and conviction decisions.

This dissertation establishes a theory that provides implications of the relationship between social institutions and delinquency. Empirical evidence from the Montréal Longitudinal Study are found to be largely consistent with the theoretical suggestions. The conclusion that social institutions such as school, family, peers, and market work have important relationships with the level of self-reported delinquency and official delinquent record yield important policy implications as discussed above.

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