Crime Rates and Economic Factors in Canada

by

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Abstract

In the 1990s in the United States, crime fell in all categories and all parts of the country. This thesis examines whether or not this phenomenon occurred in Canada. In addition, it will examine the effect of socioeconomic factors on crime rates in Canada. Finally, I will observe whether this trend continued into the 2000s.

Regression analysis is the main tool of analysis adopted in my thesis. In particular, time-series data (collected at the provincial level) will be utilized to estimate a panel data regression model.

Provincial data are collected from CANSIM for the 1990-2009 period to conduct the panel data analysis. The following provinces are included in the sample: Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. Dependent variables consist of the overall crime rate, as well as violent and property crime rates. In terms of explanatory variables, factors that relate to population demographics (age, education and immigration), economic conditions (per capita income, unemployment, poverty rate, social assistance) and law enforcement (number of convicts and police expenditures) are included in the specification. Fixed effects models are adopted to control for time-invariant, province specific unobserved heterogeneity.

Based on the regression results, key socioeconomic variables that might impact crime rates appear to be: GDP per capita, convicts, and police expenditures

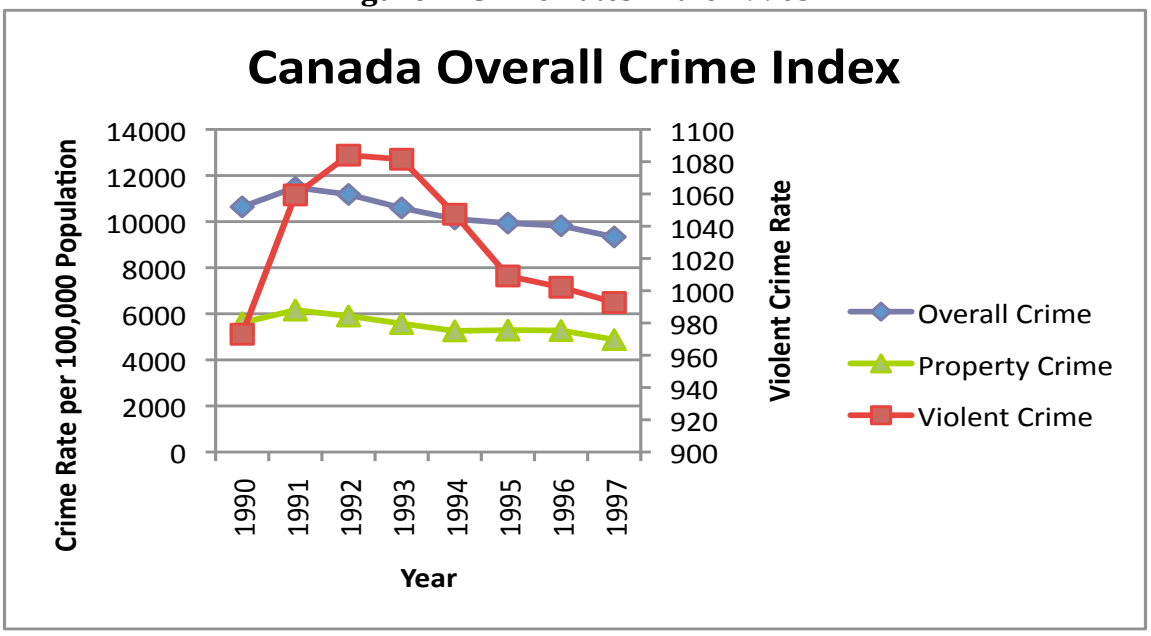
Chapter 1: Introduction

In political poll after poll, crime is notably the number one public concern. Crime imposes tremendous costs. Freeman (1996) indicates that the cost of crime in the United Sates in the 1990s may have been around 4% of their GDP.

According to Levitt (2004) during the 1990s in the United States, crime dropped dramatically. Homicide rates were relatively steady at about 4-5 per 100,000 population from 1950-1960, when they started rising to a peak of 10.2 per 100,000 population in 1980. From 1980-1991, the rate fluctuated between 8-10 per 100,000 population. After that it began to steadily decline and between 1991 and 2000 homicide rates per capita fell from 9.8 to 5.5 per 100,000 population, translating to a drop of 44%. The decline was observed across all states in the United States and all age ranges.

The declining crime rate occurred in Canada as well (See Figure 1).

Figure 1. Crime Rates in the 1990s



Source: CANSIM table 2520013

Since Gary Becker's work in 1968 on the economics of crime, it has been well noted that economic factors are associated with crime. He presented a principle-agent model of crime and punishment stating criminals are rational, self-interested agents whose behavior is best understood as an optimal response to the incentives set by the government via expenditures on law enforcement and corrections. (Becker 1968 cited in DiIulio 1996).

This thesis investigates the relationships between crime rates and demographics, economic conditions, and law enforcement variables. Through a panel regression analysis across eight provinces in Canada and with the 1990-2009 time period, I conclude that there are significant relationships between crime rates and socioeconomic factors in Canada. Based on the regression results, key socioeconomic factors include: GDP per capita, police expenditures, and number of convicts.

A literature review of models that relate socioeconomic factors and crime rates is presented in chapter 2. Chapter 3 relates to methodology, where regression analysis and choice of variables in the regression specification will be discussed in detail. The regression model results for overall crime rates, violent crime rates, and property crime rates are presented in Chapter 4, along with consequent policy implications. Chapter 5 provides conclusions of the research.

Chapter 2: Literature Review

2.1 Cost of Crime to Society

Crime is associated with tremendous costs. Therefore, before analyzing the determinants of crime, I will illustrate the cost of crime to society using various studies from the literature. Freeman (1996) estimates the overall cost of crime to be around 4 per cent of gross domestic product in the United States in the early 1990s. He concludes that around half of this cost is direct loss, meaning the monetary loss associated with the actual crime committed. The remaining fifty per cent of costs is from resources dedicated to private and public control of crime activities. However, this figure pays little attention to how crime has changed over time, as it is an estimate that pertains only to the 1990s (Becsi 1999).

A few studies in the United States have estimated the societal cost of crime for particular offenses. This is demonstrated in Table 1.

Table 1. Summary of the Incident Crime Cost Estimates

Type of Crime	Aos et al. (2001)[1]	Cohen (1988)[2]	Cohen et al. (2004)[3]	Miller et al. (1993)[4]	Miller et al. (1996)[5]	Rajkumar & French (1997)[6]	*Present Study*[7]
Murder	$4,423,614		$11,350,687	$4,144,677	$4,380,559		$8,982,907
Rape/Sexual Assault	$369,739	$97,962	$286,277	$80,403	$124,419		$240,776
Assault	$105,545	$23,025	$84,555	$24,987.	$21,451	$76,829	$107,020
Robbery	$219,286	$24,168	$280,237	$33,036	$18,591	$33,143	$42,310
Arson				$41,900	$53,629		$21,103
Larceny/Theft		$344			$529	$1,104	$3,532
Motor Vehicle Theft		$6,006			$5,720	$1,723	$10,772
Household		$2,575	$30,197		$2,145	$1,974	$6,462
Burglary							
Embezzlement							$5,480
Fraud							$5,032
Stolen Property	$22,739					$151	$7,974
Forgery and Counterfeiting						$833	$5,265
Vandalism							$4,860

Source: McCollister et al. 2010. "The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation."

Aos et al. (2001) estimated the cost and benefits of crime prevention programs. Through a per-incident cost analysis, they are able to interpret the costs for six types of crime using data from Washington state and methods used by Miller et al. (1996). These six categories include: murder/manslaughter, rape/sex offenses, robbery, aggravated assault, felony property crimes, and drug offenses. The Washington Criminal Justice System estimates were combined with victim cost information from Miller et al. (1996). Total costs (first reported in 2000 U.S. dollars) were $4.4 million per act of murder/manslaughter, $219,286 per robbery, $369,739 per rape/sexual assault, $105,545 per aggravated assault, $22,739 per property offense, and $28,121 per drug offense (Aos et al. cited in McCollister 2010).

Using a slightly different approach, Cohen (1998) demonstrates how to estimate a monetary value for pain, suffering and fear in personal injury cases. He does this by combining victim injury data with jury award. Using research done by Viscusi (1983), Cohen set the value of a statistical life at $2 million. Then, by multiplying the value of statistical life by corresponding FBI-reported crime-elated death rates, a monetary value for the risk of death in each crime category was calculated. Cost estimates (first reported in 1985 U.S. dollars) included $97,962 per rape/sexual assault, $23,025 per aggravated assault, $24,168 per robbery, $344 per larceny/theft, $6,006 per motor vehicle theft, and $2,575 per household burglary (Cohen 1998 cited in McCollister 2010).

Estimates from Miller et al. (1993) combined the jury compensation approach (noted previously) for calculating intangible victim costs, combined with direct victim cost data from 1987 to 1990, to estimate the per-offense cost of crime

across four crime categories (rape, assault, robbery, and arson). First reported in 1989 U.S. dollars were $4.1 million for a murder, $80,403 for a rape/sexual assault, $24,987 for an aggravated assault, $33,036 for a robbery, and $41,900 for an act of arson (Miller et al. 1993 cited in McCollister 2010).

Miller et al. (1996) calculated an aggregated societal cost of crime for all criminal activity in the United States (first reported in 1993 U.S. dollars). Using NCVS data, victim losses due to crimes against individuals and households were estimated at $450 billion ($1,800 per resident) per year from 1987–1990. These losses include $18 billion in medical and mental health care spending, $87 billion in other tangible costs, and $345 billion in pain, suffering, and reduced quality of life. Rape had the highest annual victim costs of all offense categories at $127 billion per year ($124,419 per offense). Per-offense crime cost estimates were also presented for murder ($4.4 million), aggravated assault ($21,451), robbery ($18,591), arson ($53,629), larceny/theft ($529), motor vehicle theft ($5,720), and burglary ($2,145)[1] (Miller et al. 1996 cited in McCollister 2010).

A more recent study, Cohen et al. (2004), using a willingness-to-pay approach, attempted to portray the social costs of crime. Data, collected from more than 1000 residents in the United States, showed that the average household was willing to pay $100-$150 per year for programs that would reduce burglary, serious assault, armed robbery, rape/sexual assault, and murder by 10% in its neighborhood. Based on the amounts respondents were willing to pay to prevent each individual type of crime, murder was found to be the most costly crime at $11.4

[1] These estimates excluded crime career costs and included only police and fire services in criminal justice system costs, leaving out major elements such as legal, adjudication, and corrections costs.

million per offense. Per-offense costs were also estimated for rape/sexual assault ($286,277), armed robbery ($280,237), serious assault ($84,555), and burglary ($30,197) (Cohen et al. 2004 cited in McCollister 2010).

Rajkumar and French (1997) estimated the (per offense) societal cost of crime throughout a broad list of offense categories. The study found that aggravated assault was the most costly crime category[2] with a total societal cost of $76,829 per offense[3]. The cost per offense for the other categories ranged from $32 for drug law violations to $33,143 for robbery (Rajkumar and French 1997 cited in McCollister 2010).

A more current study done by McCollister et al. (2010) advances previous studies, and replicates the approach of Rajikumar and French (1997) to update the per unit cost of crime. Their findings are presented in Table 1.

Zhang (2008) estimates of the social and economic costs of crime in Canada. These costs are demonstrated in Tables 2 and 3.

[2] Murder was not included among the crime categories.

[3] First reported in 1992 U.S. dollars

Table 2. Estimated Tangible Costs of Crime in Canada

Cost Category[b]	Costs $ (millions)	Main Data Sources
Criminal Justice System Costs		
Police	**$8,587**	CCJS
Court	**$672**	CCJS
Prosecution	**$528**	CCJS
Legal aid	**$373**	CCJS
Corrections	**$4,836**	
a. Adult Corrections	$3,869	CCJS
b. Youth Corrections	$967	CCJS
Criminal Code Review Board	**$12**	PT Review Boards
TOTAL CRIMINAL JUSTICE SYSTEM COSTS	**$15,009**	
Victim Costs[c]		
Health Care	**$1,443**	
a. Medical Attention from a Physician	$2	GSS 2004[d]
b. Medical Attention at a Hospital	$63	GSS 2004[d]
c. Hospitalization	$47	GSS 2004[d]
d. Direct Health Care for Illicit Drug Users	$1,294	CCSA
e. Direct Health Care Due to Drinking and Driving	$37	Transport Canada
Productivity Losses	**$6,734**	
a. Lost Wages	$971	GSS 2004[d]
b. Lost Household Services	$382	GSS 2004[d]
c. Lost School Days	$33	GSS 2004[d]
d. Lost Child Care	$11	GSS 2004[d]
e. Productivity Losses for Illicit Drug Users	$5,337	CCSA
Stolen/Damaged Property	**$6,143**	
a. Property Stolen/Damaged Due to Property Crime	$5,777	GSS 2004[d]
b. Property Damaged Due to Impaired Driving (Drugs)	$76	CCSA
c. Property Damaged Due to Drinking and Driving	$289	Transport Canada
TOTAL VICTIM COSTS	**$14,320**	
Third-Party Costs		
Funeral and Burial Expenses	**$4**	CCJS
Other People Harmed/Threatened During the Incidents[e]	**$102**	
a. Health Care	$65	GSS 2004[d]
b. Productivities Losses	$37	GSS 2004[d]
Lost Production/Services of Other People	**$1,054**	

a. Lost Production/Services of Family Members	$375	GSS 2004[d]
b. Lost Production/Services of Friends/Neighbours	$372	GSS 2004[d]
c. Lost Production/Services of Co-workers	$259	GSS 2004[d]
d. Traffic Delays Due to Drinking and Driving	$47	Transport Canada
Victim Services and Compensation Programs	**$451**	2008 VSS
Shelters for Victims	**$254**	2008 THS
Other Expenditures Related to Crime	**$238**	
a. Law Enforcement	$115	Public Safety
b. Enhancing the Public Prosecution Service	$16	Finance Canada
c. National Crime Prevention Strategy	$34	Public Safety
d. Enhancing Federal Corrections System	$61	Finance Canada
TOTAL THIRD-PARTY COSTS	**$2,091**	
TOTAL TANGIBLE COSTS	**$31,420**	

Source: Zhang, 2008.

According to Zhang, the cost of crime can be divided into two categories, tangible costs and intangible costs. In 2008, the total tangible social and economic costs of Criminal Code offences in Canada were approximately $31.4 billion. This cost amounted to a per capita cost of $943 per year. The tangible costs pertaining to the Criminal Justice System in 2008 were about $15 billion. This included: policing, court, prosecution, legal aid, correctional services and mental health review boards costs. The most direct tangible cost is the cost subjected on the victim. Of the total estimated costs, $14.3 billion was incurred as a direct result of crime, for such items as medical attention, hospitalizations, lost wages, missed school days, stolen/damaged property. With the most significant impact of crime being borne to the individual, the third-party suffers as well. The total costs to the third-party were about $2.1 billion, including the costs to other people hurt or threatened in the

incidents, government expenditures for providing victim services, running shelters and operating national crime prevention strategies, etc.

Crime can also be divided into intangible costs. In 2008, the total intangible costs were about $68.2 billion. This increased the total cost of crime to $99.6 billion. These individual costs are demonstrated in Table 3.

Table 3. Estimated Intangible Costs of Crime in Canada

	Costs $ (millions)	Main Data Sources
Intangible Costs[f]		
Pain and Suffering	**$65,100**	GSS 2004[d]
Loss of Life	**$3,055**	CCJS
TOTAL INTANGIBLE COSTS	**$68,155**	

Source: Zhang, 2008.

2.2 Supply and Demand of Crime

The economic model used by Hellman and Alper associated with crime assumes that criminals are rational and therefore make rational economic choices[4]. When taking into account the decision to participate in illegal activity, criminals assess the expected gains and costs from various actions. There are two types of gains that can be extracted: monetary and psychic. Stealing property or murdering for insurance are examples to how crime can yield monetary gains. For some types of crime, the exact monetary gain is known going into the crime. For example, if a criminal is after money in a safe and knows the set amount, he is aware of his monetary gain before participating in the criminal action. However, in other cases, only the expected value or average monetary value to be gained is known. The second type of gain, psychic, is dependent on the crime. Psychic gains can include,

[4] This may not be the case for all types of crime (i.e. violent crimes in particular)

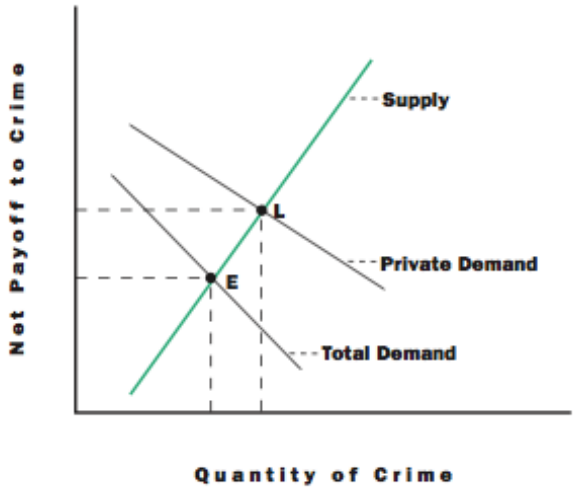
the thrill of dangers or utility of risk, a feeling of getting back at the system, peer approval, a sense of accomplishment, and so on. Psychic gains are not straightforward as they depend on the individual committing the crime. For example, the psychic gains to a juvenile from auto theft are likely to be larger than those to an adult professional (Hellman and Alper 1997).

The costs of engaging in criminal activities are more diverse. Firstly, there are material costs such as tools and equipment to carry out the criminal activity. Secondly, there is the opportunity cost of crime, which is, rather than committing an illegal act; the criminal could be doing something else such as earning a legal wage or salary. Thirdly, there are expected punishment costs, where the criminal accounts for the possibility of being caught and being punished in the form of a fine or prison term. Lastly, there is the psychic cost, which would include the fear, anxiety, or guilt of carrying out the criminal activity (Hellman and Alper 1997).

With the supply and demand of crime there are usually three sets of actors considered: criminals, noncriminal households and legitimate businesses, and the government. To be straightforward, criminals determine the supply of crime and the rest of society determine the demand for crime. The supply of crime is a choice between legitimate activities/work or criminal activities. This choice is dependent on the net payoff to crime, which Becsi defines as "the payoff to the criminal activity itself (or loot) above all other costs associated with the crime" (Becsi 1999, p. 39). The supply of crime is positively related to the net payoff to criminal activities. The supply of crime represents an inverse demand for insurance and protection. This increases the direct cost of criminal activity, therefore reducing the amount of

crimes committed. Factors that shift the supply curve to the right include: a higher proportion of youth, since the younger population is more likely to commit crimes with lower legitimate earnings, fewer employment opportunities at a given wage, reductions in imprisonment, education and welfare therefore increasing the opportunity cost of committing a crime by increasing legitimate earnings. Initially, the demand for crime might sound like a confusing, contradictory topic. However, the demand for crime is like any other market good, the quantity demanded falls as the marginal benefit (defined as loot in this example) falls. Factors that shift the demand curve to the left include any change to household conditions that decrease the payoff to crime for a given rate of crime. These factors could include reductions in material well-being or economic growth or an increase in private protection. The supply and demand described above form a market model for crime, disregarding the government. The intersection of supply and demand determine the laissez-faire market equilibrium rate of crime, which is demonstrated by point L in Figure 2.

Figure 2. Supply and Demand of Crime



Source: Becsi, 1999.

The next and final actor, the government, aims to move the crime rate to a point lower than L. This implies that crime has a negative externality, as there are tangible costs and intangible costs, meaning costs to the individual and costs to the society. Governments make an attempt to equate the marginal cost of crime to the marginal benefit of spending additional money on crime prevention. The public demand for crime is also negatively sloped, similarly as private demand because as crime increases, the public will increase their efforts to reduce crime by making crime more costly to the criminal. Therefore, the total demand curve lies below the private demand curve because the combined public and private efforts at crime avoidance mean there is less crime for a given payoff to crime than if the public acted alone (Becsi 1999).

2.3 Models of Crime

According to Jacob (2011), there are three frameworks that can explain criminal activity: the rational model, the present-oriented or myopic model, and the radical political economic model. This author argues under the rational model of crime there are two fundamental assumptions to make: "Firstly, individuals are rational and choose the best option based on the available information and resources. Secondly, individuals are perceived to be promoting their self-interest by rationally selecting options that provide them with the best benefits that are expected to exceed the costs associated with these options" (p. 273). The rational model was introduced as early as the eighteenth century by philosophers such as

Bentham and Beccaria who made the argument that "the profit of crime is the force which urges man to delinquency: the pain of the punishment is the force employed to restrain him from it. If the first of these forces be the greater, the crime will be committed; if the second force is greater, the crime will not be committed" (Eide 2000, cited in Jacob 2011). The rational framework distinguishes between the static model of crime and the dynamic model of crime. With the static model of crime, individuals do not have perfect information and they seek to compare the costs and benefits of engaging in crime in a single time period in order to maximum expected benefits. With the dynamic model, individuals integrate past experience with their future behaviour and they consider multiple time periods (Jacob 2011).

The second framework used to describe criminal activity is the present-oriented or myopic model of crime. Using this model, we can explain that humans are impatient, and most people prefer immediate rewards. With this explanation economists are able to study cases where criminals are able to behave in a non-rational, impulsive, or myopic manner. When reflecting about the trade-off between the present and the future, individuals who attach greater weight to the present are said to have more "present oriented" preferences. Economists use models such as "hyperbolic discounting"[5] to examine present-oriented behaviours.

Hyperbolic discounting is assumed to reveal irrational behaviour because decisions made in this framework are not time-consistent. Time inconsistency means an individuals preferences change over time, hence, what is preferred at one point in time is not necessarily what is preferred at another point in time. This is

[5] Hyperbolic Discounting is an economic time-inconsistent model of discounting.

revealed when an individual is concerned with the immediate rather than distant future. On the other hand, a rational individual compares present and future gains and shortfalls. Hence, the desire for immediate payoff may lead an individual to commit a crime that has negative returns in the long run. Therefore, the threat of punishment is not something on the mind of a present-oriented individual because the gains from the illegal activity are in the near future.

Using individual, panel data of felony arrests by the Florida Department of Law Enforcement, Lee and McCrary (2005) examined the deterrence effects of criminal sanctions for the period 1989-2002. They sought out to examine whether there is a drop in crime rates among juveniles once they turn 18, meaning that they are tried as adults and face longer sentences. Their assumption was that patient individuals would lower their offending rates as soon as they turned 18. However, their results revealed that criminals do not make behavioral adjustments when they turn 18, suggesting that criminals are very impatient and myopic. Contrary to the rational model, which suggests that crime can be reduced by increasing the expected cost of criminal activities, it depends on the extent to which potential criminals discount their future welfare (Lee and McCrary 2005, cited in Jacob 2011).

The third framework of crime, the radical political economic model of crime, differs from the first two in that instead of focusing on the individual's decision to allocate their time, this framework focuses on key political and socioeconomic factors that sustain crime. The key factors in this model include: relative deprivation, poverty and inequality, unemployment, and class. These factors including demographics, economic conditions and policy related approaches are the

basis in which my thesis is built upon. Relative deprivation looks at the relative differences in income among different classes in society. It is assumed that individuals identify with the group to which they belong. Therefore, the deprivation factor is defined as "the distance between the particular groups' experiences compared with that of the larger society" (Jacob 2011).

The rational model implies that individuals make decisions about how to allocate their time. During this decision process they assess the costs and benefits of allocating their time to illegal activity. One key shortcoming of the rational model is that the thoughtful and planned decision-making process does not fit the impulsive, rash nature of criminal activity. Present-oriented individuals generally do not make rational decisions when they are focusing on the short-term benefits. A conclusion of the rational model is that the deterrence tools used in the rational model will not deter these offenders. The radical theories focus on a link between crime and socioeconomic factors, where changes in these factors leads to increased crime rates (Jacob 2011). This will be the focus of the analysis in this thesis.

2.4 Socioeconomic Factors that Affect Crime

Many economists use socioeconomic factors to explain the variation among crime rates, similar to the method I will be using. Becsi (1999) uses the study of crime rates to examine the variables that may be able to explain the variation in crime rates among several demographic categories in the United States. The first two variables considered are demographic variables, urban density and age. Urban population rate is thought to be associated with crime primarily because crime is

usually an urban phenomenon (Becsi 1999). In 1969, the report of the National Commission on the Causes and Prevention of Violence, argued that crime is "chiefly a problem of the cities of the nation…" (DiIIulio 1996, p. 6). Becsi (1999) uses a panel regression for the period 1971-1994 and regions among the United States to form his conclusion. Where as, Levitt (1996) uses a panel regression on a state level in the United States from 1971-1993. Levitt uses a prison population as his instrumental variable to control for a bias estimation. They both conclude that urban population is insignificant to the variation in overall crime rates. However, Becsi (1999) finds that auto theft is an urban phenomenon, however, surprisingly, murder is not. As Freeman (1996) notes "demographics of the criminal population show that those who commit crimes consist disproportionately of persons with low legitimate earnings prospects--the young, the less educated" (Freeman 1996, cited in Becsi 1999).

The next variable considered is age. Age is considered because as you get older, your opportunity cost of committing a crime increases. This is due to the fact that you are earning a higher wage and benefits, which are attractive, therefore deterring you from committing a crime. Becsi (1999) concludes that from ages 20-24 signifies a positive relationship and is highly significant, except for property crime. Similarly, from ages 15-19 Becsi concludes a significant and positive relationship, except for murder rates. Levitt (1996) comes to a similar conclusion; however, he finds that the greatest impact comes in the 25-34-age range. Therefore, this reinstates the notion that crime is associated with youth.

Next, economic conditions are examined via two variables, unemployment rate and real GDP per capita. According to Freeman (1996), on average, most criminals have very little education or labour market skills, poor employment records and low legitimate earnings. For example, in the 1991 Survey of State Prison Inmates in the United States, it was reported that 2/3 had not graduated high school. As Freeman (1999) reports, studies on the relationship between the legitimate opportunities available and crime rates have focused on the impact of unemployment and inequality in incomes on property crimes. Studies on criminal incomes find that crimes offer low skilled men, higher wages than legitimate opportunities. The unemployment rate measures reduced legitimate earnings opportunities, whereas Real GDP can be understood as a measure of general material well-being (Raphael and Winter-Ember 2001). Cantor and Land (1985), using annual time series data for the United States 1946-1982, found empirical support for a negative effect between unemployment and crime (cited in Witt et al 1999). Most time series analyses determined that crime rates are positively related to unemployment rates. Cantor and Land (1985) reported a positive effect of lagged unemployment on crime. Gould et al. (1998) found that a one point increase in unemployment raised property crimes by 2.2%.

Lastly, policy variables are considered. The first two variables are welfare expenditures and education. Welfare expenditures can be thought as reducing the "pain" from unemployment, therefore reducing the net return of crime. In 1967, the President's Commission on Law Enforcement and Administration of Justice argued, "that crime must be prevented by programs aimed at relieving poverty and

inequality" (Zhang 1997). Land et al. (1990) report that homicide rates are correlated with measures of inequality across cities. Lee (1993) found a substantive positive relation between inequality and crime rates in 1970 and 1980. Education is a measure of the proportion of individuals that have attended school in different categories including: high school and undergraduate degrees. This variable increases the opportunity costs of crime, by increasing legitimate earnings, and giving the youth tools to evaluate the costs of crime realistically (Becsi 1999).

Finally, there are three variables used to measure disincentives to crime. The first is number of convicts. According to Levitt (1996) increased prison population can reduce crime through deterrence or incapacitation. The second and third relevant variables are the police expenditures and police employment respectively[6]. These variables represent the public's efforts to reduce crime and raise the expected cost of criminal activity. Elrich (1972) argues, "If more police lead to more arrests the likely results is more pretrial detention and eventually more prison and jail sentences" (Elrich 1972, cited in Marvell and Moody 1996).

[6] They are likely to have the same result quantitatively since police expenditures is a measure of police officers, medical examiners, etc.

Chapter 3: Methodology

3.1 Regression Analysis

Regression analysis is the fundamental methodological tool employed in this thesis. Regression analysis allows us to examine the relationship between explanatory independent variables believed to influence the variable of interest (the dependent variable). More specifically, regression analysis allows us to explain how the dependent variable changes when one of the independent variables change, keeping the rest of the independent variables constant (Sykes 1992).

The regression analysis is run on a provincial level. These provinces include: Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. By choosing these eight provinces, I am able to regionally represent Canada. Provinces such as Prince Edward Island and Newfoundland, and territories such as Nunavut and Yukon are omitted because the populations in these provinces and territories small relative to the other provinces.

Using the regression analysis of the eight provinces identified, I will examine the correlation between socioeconomic factors and crime rates in the 1990-2009 period. Furthermore, I can observe whether or not these trends continued into the last decade. The model specification for the regression analysis is:

$$\ln Crime_{pt} = \beta_0 + \beta_1 X_{pt} + \beta_2 time_t + f_p + \varepsilon_{pt} \qquad \text{Equation 1}$$

I adopt a log-log specification, where the dependent variable is expressed as a natural log and the independent variables, X_{pt}, are also expressed as natural logs, unless they are measured as percentages or rates. Hence, coefficients estimated with

this specification will be measuring the elasticity of crime with respect to the explanatory variables.

3.2 Data

The dependent variable, Crime, represents the overall crime rate (crimes per 100,000 population), violent crime rates and property crime rates. The crime variables for overall crime, violent crime, property crime, and the detailed crime statistics comes from two tables in CANSIM, 2520013 and 2520051. The data presented in the CANSIM table 2520051 is collected in the 1998-2009 time period using the Incident-based Uniform Crime Reporting Survey. The data collected from CANSIM table 2520013 is for the period 1990-1997, titled Crime statistics, by detailed offences, annually, uses the Uniform Crime Reporting Survey as well[7].

The explanatory variables are divided into three categories, demographics, economic conditions and law enforcement variables. Definitions of these coefficients can be found in table 4.

[7] These two tables are combined.

Table 4. Definitions of Coefficients

Coefficient	Definition
age24p	Percentage of population aged 15-24
immig15_24p	Percentage of immigrants population aged 15-24
psep	Percentage of population with post-secondary education. (Including Bachelors degrees, certificates, community college, etc)
L1.lgdppc	Lagged, Real GDP per capita (2002 dollars), measured in natural log form to represent elasticities.
urp	Unemployment Rate, overall population
ppooronsa	Percentage of Poor on Social Assistance. Measured using LICO
poverty_rate	Poverty Rate in each province
L1.lconvicts	Lagged, number of convicts in a provincial facility, measured in natural log form to represent elasticities.
L1. lpoliceexpr	Lagged, police expenditures, measured in real terms, measured in natural log form to represent elasticities.

The first category, demographics includes the age variable, the immigration variable, and the education variable. *Age24p* is measured in percentages and the range 15-24 is chosen to capture the youth demographic. This variable is obtained from CANSIM table 2820002. The next variable is *immig15_24pp*. This variable measures the percentage of population that are immigrants that are between 15-24 and is retrieved from CANSIM table 0510011. Lastly, The *psep* variable is a measure of the percentage of population that has post-secondary education this could include, university, college, certificate degrees, etc. This is retrieved from table 2820004.

The economic conditions variables include the unemployment rate, real per capita GDP, poverty rate, and the proportion of the poor on social assistance. The *urp* variable is a measure of the unemployment rate measure across all ages. This is retrieved from CANSIM table 2820008. The variable *L1.lgdppc* is a measure of the

real GDP per capita as a percentage. This data is retrieved through CANSIM table 3840002 and lagged a period[8], similar to police expenditures and convicts, to capture the true effect. The *poverty_rate* variable is used in conjunction with LICO (Low Income Cut off). This rate has a base year of 1992 and it retrieved from two sources. The first time series, 1990-1996, comes from the Survey of Consumer Finance. Whereas, the second time series, from 1996 onwards, comes from the Survey of Labour Income Dynamics. Lastly, the variable *ppooronsa* is a measure of the percentage of poor people on social assistance[9].

Lastly, there are variables that are related to law enforcement in society used in the regression. The variable *lconvicts* is a measure of how many criminals sentenced, remanded, and other statuses counts and exclude inmates temporarily not in custody at the time of the count. This data is retrieved from CANSIM table 2510005. This data is then lagged one period to take into account the incapacitation effect. The incapacitation effect is an effect that takes place when individuals are put in prison. These criminals are therefore not able to commit crimes dues to their incapacitation. The l*policeexppr* variable is retrieved from table 2540002 and is a measure of total expenditures in that province on policing. This is expressed as in real terms (2002 dollars)[10]. Lastly, I have used time dummy variables G1-G20 to control for year specific shocks that could have occurred during this time period that may be correlated in some way to the variables chosen. Hence, by including

[8] Lagged values of these variables have been adopted in my specification to decrease the level of endogeneity of these variables but this might not have eliminated the problem completely.

[9] The number of people on social assistance is retrieved from CANSIM table 2020404. The proportion of poor people on social assistance is calculated by dividing the number of people on social assistance by the poverty rate multiplied by the population.

[10] I used the CPI series (base year 2002) to deflate.

these time dummy variables, I intend to limit the possibility of endogeneity in my regression.

Chapter 4: Results

4.1 Regression Results

The model is as follows:

$$\ln Crime_{pt} = \beta_0 + \beta_1 X_{pt} + \beta_2 time_t + f_p + \varepsilon_{pt} \qquad \text{Equation 2}$$

Crime is the dependent variable measured as in log form. X represents a matrix, which consists of explanatory variables that relate to demographics, economic conditions, and law enforcement variables. Time represents the time dummy variables used to control for natural shocks that may have occurred in a given year that could have been related to my independent variables making them biased. Lastly, f_p denotes the fixed effects at the provincial level that controls for province specific time invariant factors that might affect the crime rate in each province.

This section highlights the results from the regression analysis presented in the Chapter 3[11]. For the purpose of interpreting, the overall crime model will be referred to as Model 1, the violent crime model as Model 2, and the property crime model as Model 3. The regression results are presented in tables 5-7.

Model 1 yields the following results for overall crime rates.

[11] Something to note is that I initially had planned on running an Instrumental Variables Regression. However, due to time constraints, I ended up running a fixed effects model. Therefore, due to not running and IV estimation, I do acknowledge that my coefficients could be biased. However, the duration of my thesis will assume that these coefficients are in fact true, and I will conduct my analysis accordingly.

Table 5. Overall Crime Rates Regression

Variable	Coefficient	Std. Error	t-Statistic	P-value
age24p	0.0183	0.0193	0.95	0.344
immig15_24p	1.8843	0.3342	5.64	0.000
psep	-0.0442	0.0079	-5.58	0.000
L1.lgdppc	-1.0338	0.3418	-3.02	0.003
urp	0.0139	0.0117	1.19	0.235
ppooronsa	-0.0023	0.0010	-2.29	0.024
poverty_rate	-0.0173	0.0077	-2.24	0.027
L1.lconvicts	-0.2910	0.0791	-3.68	0.000
L1. lpoliceexpr	-0.7758	0.1638	-2.74	0.000

R-Squared (within):	0.7646
R-Squared (between):	0.0564
R-Squared (overall):	0.0608
Number of Observations:	152
F-statistic:	14.08
Prob(F-statistic):	0.0000

In terms of demographic variables, the *age24p* coefficient is estimated at 0.0183, which implies a 1% increase in proportion of age from ages 15-24 corresponds to a 0.0183% increase in crime rates. However, this coefficient is insignificant at the 5% level of significance. The *immig15_24pp* coefficient[12] is estimated at 1.8843, which implies a 1% increase in proportion of immigrants from ages 15-24 corresponds to a 1.8843% increase in crime rates. This coefficient is significant at the 5% level of significance. This is consistent with the notion that the younger category of immigrants would come to Canada without a particular skill or

[12] Initially, I had run a regression with percentage of immigrants in a provincial population, however, this was insignificant and decided to separate this category into two age categories: young and mature. Running a regression with an older age category and younger age category of immigrants suggested a conclusion that they had opposing effects on crime rates. Therefore, I chose to include solely the younger age category, (15-24 year olds), as these immigrants may have come to Canada as refugees or in the family class, meaning they may not possess high levels of education or a particular skill. As the literature review suggests, this is likely to be related to crime.

high level of education, therefore, their opportunity cost to committing crimes is significantly decreased. The *psep* coefficient is estimated at -0.0442, which implies a 1% increase in proportion of post secondary education population corresponds to a 0.0442% decrease in crime rates. This coefficient is significant at the 5% level of significance. This is expected since the higher education you have the higher opportunity cost you have to committing crimes, therefore, making it more attractive to not commit crimes.

The economic conditions variables such as GDP per capita, unemployment rate, poverty rate, and poor on social assistance for overall crime rates depict the following results. The *L1.lgdppc* coefficient is estimated at -1.0338, which implies a 1% increase in real GDP per capita from last year corresponds to a 1.0338% decrease in crime rates. This coefficient is significant at the 5% level of significance. This is consistent with the notion that the higher per capita income an individual receives, the less likely they are to commit crimes to gain monetary reward. The *urp* coefficient is estimated at 0.0139, which implies a 1% increase in unemployment rate corresponds to a 0.0139% increase in crime rates. However, this coefficient is insignificant at the 5% level of significance. The *ppooronsa* coefficient is estimated at -0.0023, which implies a 1% increase in percentage of poor on social assistance corresponds to a 0.0023% decrease in crime rates. This coefficient is significant at the 5% level of significance. This makes economic sense as the proportion of individuals on social assistance increases, we expect that less will need to commit crimes. The *poverty_rate* coefficient is estimated at -0.0173, which implies a 1% increase in poverty rate corresponds to a 0.0173% decrease in crime rates. This

coefficient is significant at the 5% level of significance. This is unexpected because this implies that an increase in poverty rate translates to a decrease in crime, which contradicts the literature.

Lastly, the law enforcement variables, which includes convicts and police expenditures yield the following results. The *lconvicts* coefficient is estimated at -0.2910, which implies a 1% increase in convicts last year corresponds to a 0.2910% decrease in crime rates. This coefficient is significant at the 5% level of significance. This is consistent with expectation as this can explain the incapacitation effect. The *lpoliceexpr* coefficient is estimated at -0.7758, which implies a 1% increase in police expenditures last year corresponds to a 0.7758% decrease in crime rates. This coefficient is significant at the 5% level of significance. This is consistent with my prediction as the amount of money allocated to policing increases, you are likely to see an increase in police employment, therefore, more police officers to contain crime.

The r-squared value represents what proportion of variation in the dependent variable can be explained by variation in the independent variables. The within value measures the how much variation in crime rates can be explained using the independent variables in one province across time. This value is 0.76, which is fairly high, depicting that we are able to explain the overall variation in crime rates across time suitably. The between r-squared value, represents the variation in crime rates explained by our independent variables across provinces, keeping time constant. This value is 0.06, which is quite low, however, the purpose of this study was primarily to explain the variation in crime rates across time. Lastly,

my overall r-squared value is 0.06 as well, which represents the variation in crime rates over time and across provinces using our independent variables.

From the overall crime rate regression results there are three variables in particular that are obvious due their magnitude of relationship to crime rates. These variables are GDP per capita, convicts, and police expenditures. A detailed discussion on these variables will be presented in the next section.

Turning to Model 2, the property crime regression we see similar results.

Table 6. Property Crime Rates Regression

Variable	Coefficient	Std. Error	t-Statistic	P-value
age24p	0.0033	0.0212	0.16	0.876
immig15_24p	2.3521	0.3675	6.40	0.000
psep	-0.0540	0.0087	-6.20	0.000
L1.lgdppc	-0.8695	0.3759	-2.31	0.022
urp	0.0081	0.0129	0.63	0.528
ppooronsa	-0.0012	0.0011	-1.04	0.300
poverty_rate	-0.0026	0.0085	-0.30	0.762
L1.lconvicts	-0.2680	0.0870	-3.08	0.003
L1. lpoliceexpr	-0.8796	0.1801	-4.88	0.000

R-Squared (within):	0.7172
R-Squared (between):	0.0015
R-Squared (overall):	0.0041
Number of Observations:	152
F-statistic:	10.99
Prob(F-statistic):	0.0000

The age coefficient is still insignificant along with unemployment. However, with property crime, the *ppooronsa* coefficient is insignificant along with *poverty_rate*. Also, the *lpoliceexpr* variable is larger for property crime. This makes economic sense because property crimes are crimes that can be viewed, therefore,

the more expenditures that you are allocating towards policing, the more police on the streets to witness property crimes.

For Model 3, the violent crimes regression, we observe the following results.

Table 7. Violent Crime Rates Regression

Variable	Coefficient	Std. Error	t-Statistic	P-value
age24p	-0.0433	0.0237	-1.82	0.071
immig15_24p	1.1362	0.4121	2.76	0.007
psep	-0.0074	0.0098	-0.76	0.450
L1.lgdppc	-0.7539	0.4215	-1.79	0.076
urp	0.0293	0.0144	2.03	0.045
ppooronsa	-0.0025	0.0013	-1.96	0.053
poverty_rate	-0.0339	0.0096	-3.55	0.001
L1.lconvicts	-0.4307	0.0975	-4.42	0.000
L1. lpoliceexpr	-0.5275	0.2020	-2.61	0.010

R-Squared (within):	0.8860
R-Squared (between):	0.2536
R-Squared (overall):	0.2420
Number of Observations:	152
F-statistic:	33.69
Prob(F-statistic):	0.0000

Age is still insignificant, similar to the overall crime regression. With violent crime however, we have more insignificant coefficients such as: education, real GDP per capita, and poor on social assistance. This however can be expected because, some proportion of violent criminals are not acting rationally, and therefore, I may not be able to explain their actions using variables like income per capita and education.

Overall, looking at the regression results, we can see that variables chosen to represent different dimensions of crime rates (demographics, economic conditions,

and law enforcement) are able to explain to some degree the downward trend in crime rates over the last two decades.

Chapter 5: Conclusion

By looking at the regression results, it is clear that there are three variables in particular that stand out due to their magnitude of the relationship with crime rates in Canada. The first variable is *lconvicts.* Where an increase of 1% in convicts last year, corresponds to a decrease of 0.29% of crime rates. To determine the cost of increasing the prison population by 1%, I have estimated the overall cost of conviction for the "average" province in 2008. These costs include: total criminal court costs, total prosecution costs, total legal services costs, provincial correction costs, and criminal code review board expenditures[13]. The total cost of convictions for a province amounts to $6.9 billion[14]. Therefore to increase the number of convicts by 1% it would cost 1% of $7 billion, which is $70 million. This cost would translate to reducing crime by 0.29%. Criminal justice comes at a very high cost, therefore, it comes at no surprise that this is not a very cost-effective policy to reduce crime. To conclude, it would cost $70 million to reduce crime by 0.29% via increasing the number of convicts. This translates to ($70 million * 3.45[15]) which would equal $241 million to decrease crime by 1%.

Secondly, *lpoliceexpr* variable concludes that a 1% increase in police expenditures corresponds to a decrease of 0.77% in crime rates. To determine the cost of increasing police expenditures by 1% through a cost analysis, I have concluded that the average police expenditures across Canada, using 2008 dollars is

[13] These costs come from Zhang (2008). All costs are measured in 2008 dollars.

[14] For ease of explanation, I have rounded this number to $7 Billion.

[15] Since 1% increase in number of convicts from the previous period amounts to 0.29% reduction in crime rate, number of convicts has to be increased by 3.45% in order to decrease the crime rate by 1%.

$1.09 billion. Therefore, to increase police expenditures by 1% it would cost $10.9 million[16], reducing crime by 0.77%. This is probably the most cost-effective way to reduce crime rates relative to the other solutions. To conclude, it would cost $10 million (as a result of 1% increase in police expenditures) to reduce crime by 0.77% using police expenditures. This translated to ($10 million * 1.30[17]) which would equal $13 million to reduce crime by 1%.

Lastly, *L1.lgdppc* variable shows that a 1% increase in real GDP per capita last year corresponds to a decrease of approximately 1% in crime rates. To analyze the cost of increasing GDP per capita by 1%, I have determined that GDP was around $39,500 in 2008[18]. By calculating 1% of this number would mean that it would cost $395 per Canadian household to reduce crime by 1.03%. According to the 2006 Census, there were on average 12.5 million households in Canada. Therefore this solution would cost roughly $3.53 billion[19], to reduce crime by 1.03%, hence not a very cost effective solution.

These results are summarized in Table 8.

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16 This analysis is assuming that all costs increase by 1%, which may not be the case, some may increase by more, and some may decrease.

17 Since 1% increase in police expenditures from the previous period amounts to 0.77% reduction in crime rate, amount of police expenditures has to be increased by 1.3% in order to decrease the crime rate by 1%.

18 Retrieved from CANSIM table 384-0002

19 Using results from Department of Finance Canada (2011), the government spending multiplier is estimated to be 1.4 for general spending measures as of the fourth quarter of 2010. This would imply that in order to increase the per capita GDP by $395 (1% of real GDP per capita), the government would need to increase its per capita spending by $282 ($395/1.4) per household. Which amounts to a total cost of $3.53 billion dollars ($282*12.5 million households)

Table 8. Cost of Crime Reduction by 1% Using Policy Variables

Variable	**Cost of Reducing Crime by 1%**
Convicts	$241 million
Police Expenditures	$13 million
GDP Per Capita	$3.53 billion

In conclusion, combining the regression results with the cost of implementing these changes among the three policy variables, increasing police expenditures seems to be the most cost-effective way to reduce crime rates.

The purpose of this thesis was to examine whether socioeconomic factors such as demographics, economic conditions, and law enforcement variables, had an effect on crime rates in Canada. Using eight provinces and a time period of 1990-2009, regression analysis was adopted as the main methodological tool. The dependent variable was the crime rate per 100,000 population, which was regressed against socioeconomic factors such as demographics, economic conditions, and law enforcement variables, controlling for time invariant factors and year specific shocks. The data was collected from CANSIM tables from Statistics Canada.

Looking at the regression results, it is clear that crime rates in Canada during the 1990-2009 time period were effected by socioeconomic factors. For overall crime rates, my results indicate a positive and significant relationship between crime rates and young immigrants (15-24 years old). My results indicate a negative and significant relationship between crime rates and education, GDP per capita, percentage of poor on social assistance, poverty rate, convicts, and police expenditures.

The results imply the most significant relationship between crime rates and police expenditures, convicts, and GDP per capita. As mentioned earlier, this could implicate policy adjustments by performing cost benefit analysis. By doing so, it is clear that the most cost effective manner to reduce crime is through increasing police expenditures.

The study requires further research. Since I was not able to run an instrumental variable regression, as noted, hence my coefficients would be biased if some of the explanatory variables, such as number on convicts and amount of police expenditures are correlated with idiosyncratic crime related shocks[20]. Therefore, future research in this area could include a regression run with IV Estimation. In addition to this, it would have been interesting to further investigate why the poverty rate coefficient was delivering the incorrect sign, but still significant at the 5% level. Lastly, with the recent passing of the crime bill in Canada, Bill C-10, it would be noteworthy to examine closely my results with the specifics of the new crime bill.

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