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Law Enforcement Expenditures and Crime Rates in Canadian Municipalities: A Statistical Analysis of How Law Enforcement Expenditures Impact Municipal Crime Rates in Canada

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Abstract

Previously published studies attempting to test the relationship between law enforcement expenditures and crime rates have mostly been restricted to analyzing American data and have produced mixed conclusions. This study employs data from the Police Resources in Canada reports from 1999-2007 and Census data from 2001 and 2006 to analyze what impact law enforcement expenditures have on municipal crime rates. Through the use of multiple-regression and the implementation of lagged variables, it is found that although a significant absolute relationship between expenditures and crime rates exists, there is no indication that law enforcement expenditures have an impact of statistical significance on crime rates. This means increases in expenditures to deter crime may not be justifiable. Furthermore, this conclusion provides rationalization for the reallocation of financial resources by municipalities towards programs or services that more effectively deter crime.

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Introduction

Crime can be a significant detriment to municipalities, businesses, and citizens. For this reason, municipalities have attempted to take measures that will reduce the crime rates within their jurisdictions—mostly through changes to the police services that serve the area. These changes deal with the way crime is combated, the organization of social programs, and fluctuations in police levels. The effects of many of these changes on crime rates have been studied in the United States, and only minimally in Canada. Consequently, the following research paper analyzes the impacts of changes in policing on crime rates in Canadian municipalities. More specifically, it analyzes whether municipalities' per capita law enforcement expenditures significantly impact the crime rate of that municipality. This crime rate will be separated into three categories for purposes of analysis: all incidents of crime, violent crime, and property crime. With many municipalities bearing the burden of high police expenditures, it is an area that warrants attention.

Currently literature related to this question has not satisfactorily formed conclusions, often resulting in theories that conflict between scholars. For this reason, the theories found within this literature are reviewed to ensure that adequate steps are taken in analyzing the research question effectively. The result of this process will be the formulation of measurement and analysis techniques (univariate, bivariate, and multivariate statistics) that provide statistical evidence towards a set of conclusions regarding the relationship between law enforcement expenditures and crime rates. By utilizing regression techniques involving lags on the dependent variable, and by focusing on Canadian municipalities, their respective per capita law enforcement expenditures, crime rates, and a series of control variables, the impact of law enforcement expenditures and crime rates will be identified and explained.

Literature Review

The study of the relationship between law enforcement expenditures and crime rates is one that has taken different dynamics over the last several decades with much of the academic literature having been accrued from the mid-1970's to mid-1980's (Marvell and Moody 1996: 614-616). During this time, analysis focused on whether or not a relationship between the factors existed, and if so, what the impact was of each variable on the other. More recently, literature has focused less on police expenditures in general, and more on the impact of short term grants or financial programs on crime rates in a given area (Worrall and Kovandzic 2007). Unfortunately, all of these statistical analyses have formed different conclusions about the impact of law enforcement expenditures on crime rates. Furthermore, there is yet to be a study that specifically analyzes the relationship between expenditures and crime rates at a municipal level within a Canadian context. This justifies the formulation of the paper.

The literature to date is quite extensive, with most statistical analyses focusing on municipalities, counties, or states within the United States of America. Within this literature, both law enforcement expenditures and the number of police officers are considered to determine their relationship with crime rates. Studies focusing on the number of police officers are relevant to this research paper because "the correlation between police employment and police spending is very high, [so] it is virtually a matter of indifference whether one variable or the other is used in a given study" (Greenberg, Kessler, and Loftin 1983: 390). Furthermore, law enforcement expenditures and the number of police officers are both measures of police strength, and are often referred to in the literature as 'police levels'.

Much of the current literature studies the relationship between police levels and crime rates with reference to the "economics of crime"; a theory discussed in the work of

Isaac Ehrlich (Avio and Clark 1978: 2; Marvell and Moody 1996: 609; Kovandzik and Sloan 2002: 65). This approach, which employs economic theory, proposes that law enforcement acts as a means of deterring future crimes. It is suggested that, “even if those who violate certain laws differ systematically in various respects from those who abide by the same laws, the former, like the latter, do respond to incentives: the opportunities (costs and gains) available to them in legitimate and illegitimate pursuits” (Ehrlich 1972: 260). According to this theory, increased police levels will lead to a greater likelihood of apprehension, thus creating a higher opportunity cost for potential criminals, and consequently resulting in lower crime rates. On the other hand, if offenders can avoid prosecution or apprehension because of ineffective law enforcement, they will be more likely to commit crime, resulting in increases in a region’s crime rate (Pare, Felson, and Ouimet 2007: 244). Therefore, increases in police levels would have a negative impact on crime rates.

Ehrlich’s theory is challenged by several academics. First, research has shown that criminals do not always rationalize choices in the manner suggested by the economics of crime theory because they are not limited by choices between legal and illegal activities, but also by choices of which types of crimes to commit, how many of each, how and where to commit them (Marvell and Moody 1996: 610). Second, it is suggested that if opportunity costs were to increase criminals would become more selective with the opportunities they accept, and in order to maintain past commission rates, would have to increase the number of less risky crimes they commit. This would lead to lower arrest rates and increases in the number of crimes committed (Cook 1979: 139). Third, it is possible that if offenders were deterred by changes in police levels, they would simply relocate their criminal activities to another area (Cook 1979). Finally, there is potential that certain percentages of all types of crime would be unaffected by policing levels due to their high net return, suggesting that policing has a deterrence effect on

only marginal crimes for which expected costs exceed the expected returns (Buck et al. 1983: 471).

A meta-analysis completed by Marvell and Moody (1996) provides significant insight into the lack of agreement within literature regarding the relationship between police levels and crime. The analysis summarized 36 studies that regress crime on police levels or police levels on crime, and found that little evidence suggested that higher police levels reduce crime. In contrast, it was found that higher crime leads to higher police levels. Furthermore, only 10 of 29 studies regressing crime on police found significant negative coefficients on the latter, regardless of the type of crime being calculated. Conversely, 15 of the 21 studies regressing police levels on crime found significant positive coefficients on the crime variables (Marvell and Moody 1996: 613). These findings mean that higher police levels are associated with higher levels of crime. This is similar to a meta-analysis completed by Samuel Cameron which showed 18 of 22 reviewed studies found either no relationship between police and crime or a positive relationship, while only four found a negative relationship (Cameron, 1988). While these studies have not resulted in agreement on a clear conclusion, the evidence suggesting there may be no relationship or a positive relationship between police and crime has been consistent, “regardless of (1) the study design (e.g., cross sectional or over time), (2) time period analyzed, (3) sample size, (4) measure used for police levels, (5) unit of analysis (city, state, or national), (6) type of crime (e.g., overall violent crime, overall property crime, or specific offenses), or (7) the data analytic procedures” (Kovandzik and Sloan 2002: 66).

Limited statistical research has been completed in Canada with regards to crime rates and explaining what causes them to change. Furthermore, no research has specifically analyzed the impact of law enforcement expenditures on crime rates. However, several studies have been developed that analyze how crime rates are

impacted by other forms of deterrence. Furlong and Mehay (1981) empirically investigated crime deterrence by utilizing a disaggregated data base composed of districts located within Montreal to establish the deterrence capabilities of alternative police deployment strategies on crime (Furlong and Mehay 1981: 45). Through the use of a three-equation simultaneous model they examine how clearance rates have been impacted by alternative manpower levels and police deployment, while also studying how clearance rates affect property crime rates (45). The study confirms the presence of the deterrent effect of the apprehension probability (using police clearance rates). Furthermore, they conclude that, “the level of police manpower, the geographic deployment of manpower, and the distribution of manpower by function all appear to affect the ability of the police to generate arrests and clearances and to deter crime” (55). This is of importance to the study of police expenditures and crime rates because police manpower is tied directly to the amount of money spent by a particular municipality.

Using data from the Canadian Uniform Crime Report (UCR2) from the Province of Quebec in 1998, Pare, Felson, and Ouimet (2007) use multilevel Bernoulli regressions to analyze how the characteristics of a crime and the community context in which it occurs affect the likelihood that it will be cleared by the police (243). The analysis of police workload and its impact on clearance rates is of particular importance. It is suggested that, “more crimes will be cleared if the police force is expanded” (245). Therefore, this study demonstrates that police levels (which can be interpreted to include expenditures) do impact the police’s ability to clear crime. Such a finding is relevant because one must consider whether a crime rate is more or less likely to change if a criminal understands that the opportunity cost of committing crime (as associated with clearance rates) is likely to change following an increase in police levels such as law enforcement expenditures.

The concept of opportunity cost or an “economic model” of crime, is further developed in research by Avio and Clark (1978), who employ a Canadian data base to investigate a number of hypotheses concerning the deterrent effect of incarceration, as well as to form conclusions on the empirical viability of the economic model of crime (3). The study is important for Canada because, “the Canadian criminal justice system is believed by many to rely more heavily on incarceration than criminal justice systems in other Western nations” (Avio and Clark 1978: 3). While their study is able to conclude that swiftness of trial and sentencing are an important factor in general deterrence, it does not study the deterrence potential associated with changes in police levels, such as number of police officers or expenditures (15). Furthermore, they suggest in their conclusion that implications may be drawn regarding the optimal allocation of resources among branches of the criminal justice system (18). With no analysis of how municipal law enforcement expenditures impact crime rates through deterrence, it is unlikely such a conclusion should be made regarding resources. This is especially true given the importance of financial resources that could be used for law enforcement.

In forming a regression analysis of the relationship between law enforcement expenditures and the crime rate, simultaneity problems must be accounted for. It has been noted that, “with respect to the police-crime relationship, simultaneity is clearly possible for the simple reason that governments are likely to respond to crime problems by enlarging police forces” (Marvell and Moody 1996: 611). While it is suggested that two-stage least squares (2SLS) regressions are the most common procedure for addressing simultaneity (611), the previously discussed meta-analysis shows a variety of alternative methods being utilized, including: 15 studies using 2SLS, five studies using lagged regressions, three studies using the Granger test, and 14 studies having not addressed simultaneity (614-616). It should be noted that while 2SLS may be the most common procedure, it is argued that lags between police levels and crime rates should

be used to avoid specification problems involving simultaneity (Kovandzik and Sloan 2002: 68). The use of lags involves lagging the independent variable in relation to the dependent variable by a specific unit of time, which in the case of police expenditure and crime rate studies, is generally between one and three years.

While a municipality's total crime rate is an important measure when analyzing the relationship between police levels and crime rates, so too are the rates of violent crime and property crime. It is important to separate the two because according to deterrence theory, police spending is only associated with reductions in certain types of crime (Worrall and Kovandzic 2007: 170). In theory, violent crime rates would not be impacted by changes in police levels as property crime rates would because violent crimes (such as assaults) have little premeditation. Instead, violent crimes may actually be positively impacted by increases in police levels as adding police might increase the reporting of violent crimes as there would be an increased number of police capable of intercepting violent actions (Marvell and Moody 1996: 631). Furthermore, criminology studies have confirmed that violent crime does not respond to police activity, therefore suggesting that police expenditures should respond to the levels of property crimes, as they are more sensitive to police activity (Buck et al. 1983: 485). However, contrasting arguments have been made that suggest positive changes in police levels are effective in reducing violent crime (Levitt 1997: 283). Theoretically, property crime is more likely to be impacted by changes in police levels because offenders are more premeditative in their actions, and thus have time to assess the opportunity costs of their actions. This idea is challenged, however, by those who believe property crimes are complementary goods. This means that increased police levels associated with one particular type of property crime increase/decrease the levels of other crime(s) respectively (Buck et al. 1983: 474). Such a concept suggests that a potential "natural level" of crime exists,

where changes in police levels just change the methods, severity, and location of one type of crime, which is than simply shifted to another type of crime.

A wide range of control variables have been used within existing literature, with the number of control variables generally varying from 0 to 10 (Marvell and Moody 1996: 613). Unfortunately one cannot identify all the variables that should be entered, and data is often not available for some of the variables suggested by theory (612). This means a clear set of control variables must be identified. One control variable often used within analyses is the median income of the sample being studied (Furlong and Mehay 1981; Buck et al. 1983; Worral and Kovandzik 2007; Lin 2009). It is suggested that income has a positive impact on all crimes (except robbery) because income may be a proxy for criminal earnings as well as for the opportunity cost of crime (Furlong and Mehay 1981: 53). In terms of property crime, areas with high average incomes would likely include larger amounts of property available for illegal transfer than areas with lower average incomes, thus making average income highly correlated with the victim stock (Avio, 1978, pg 8). Interestingly, no literature analyzing the police spending-crime rate relationship puts forth the idea that higher incomes could result in less crime because residents are less likely to need to resort to illegal means to satisfy their needs. Furthermore, the idea that crime is greater in low income areas because people need to commit more offences (ie. robbery) to meet their needs, is noticeably absent within the literature.

The inclusion of demographic variables is vital because crime tends to vary depending on the demographic characteristics of a region (Cornwell and Trumbull 1994: 363). Much of the American literature has focused the inclusion of visible minority groups on the percentage of the population that is African-American or Hispanic (Marvell and Moody 1996: 625; Worrall and Kovandzik 2007: 167; Lin 2009: 74). Others have found it relevant to expand this ethnic characteristic to include all of those considered to be a

minority or nonwhite (Cornwell and Trumbull 1994: 363). This inclusion has to do with the idea that areas with higher populations of visible minorities are more likely to experience higher rates of crime, often because whites perceive racial and ethnic minorities as criminal threats, therefore leading to greater crime control efforts (Holmes 2000: 349). In contrast, a Canadian study focusing on the Province of Quebec decided not to include a measure of racial composition of communities in their study. This was because their sources suggested many communities within their area of research have a very low proportion of minorities, and that minorities tend to be socially well integrated (Pare, Felson, and Ouimet 2007: 247).

It is not uncommon for the percentage of the total population that is male within a certain age range (generally 15-24, although sometimes as high as 34) to be included as a control variable (Furlong and Mehay, 1981: 46; Buck et al. 1983: 476; Kovandzik and Sloan 2002:70; Lin 2009: 74). This is because this age group is associated with the highest arrest rates, and governments may take age group trends into account when setting police levels (Marvell and Moody 1996: 625). The use of controls for young males finds support within literature studying criminal careers in the United States (Blumstein et al. 1986: 66). However, Canadian studies regarding deterrence theory have found that the percentage of the total population aged 15-24 that is male is statistically insignificant for all crimes except break and enter (Avio and Clark 1978: 13). This has led to the suggestion that Canadian youth may not share the same propensity for crime as their American peers, when other factors are held constant (Furlong and Mehay 1981: 53).

The unemployment rate is an important control variable because of its connection to the ‘economics of crime’ theory. It is suggested that because unemployment tends to reduce the opportunity cost of crime participation by individuals, the unemployment rate can be used as an explanatory variable in determining the supply of a type of criminal offence (Furlong and Mehay 1981: 47). This is particularly

relevant for property crimes such as larceny, because the unemployed are the economic group most inclined to commit such crimes since the opportunity cost of its members in the legal employment market is limited (Buck et al. 1983: 477). Interestingly, one Canadian study (Avio and Clark 1976) was not able to achieve consistent relationships between unemployment and crime, while a second study (Avio and Clark 1978) by the same authors did obtain a positive relationship between crime rates and unemployment. This is similar to another Canadian study that found unemployment rates to be positively associated with all types of crime (Furlong and Mehay 1981: 52).

A control variable that has been surprisingly absent throughout much of the literature is the total population of the regions being studied (be they cities, counties, states, etc.). It has been suggested that a possibility exists that the impact of police levels on crime would be greater in large, urban areas and in areas with higher crime rates where changes in police levels might be more effective (Kovandzik and Sloan 2002: 73). The total population can be used as a measure of how urban/rural a municipality may be. The importance of such a measure is found in one analysis which found that property crimes and police expenditures are the highest in urban communities and lowest in rural communities. Resulting from these expenditures and based on property crime data, the more urbanized a community is, the higher the levels of crime. In contrast, violent crimes do not result in any significant differences among urban, suburban, or rural communities (Buck et al. 1983: 481).

Population density has also been used as an effective control variable in several studies (Furlong and Mehay 1981; Buck et al. 1983; Cornwell and Trumbull 1994). The impact of population density on crime is an interesting one. On one hand, the higher the density, the greater the probability of a crime being witnessed, resulting in greater criminal apprehension (Buck et al. 1983: 477). Thus, a rational offender would be less likely to commit crime under the ‘economics of crime’ theory as he/she would recognize

the opportunity cost of their actions is increased in a more dense area. On the other hand, the higher the density, the larger the stock of criminals will become due to increased interactions among people leading to criminal activity (477). In relation to expenditures, the higher the density, the more expensive it is to provide the same levels of police protection, due to limits on the visual range of patrolman (478). In contrast, other research has shown that denser areas require fewer officers to provide the same level of service as provided in less dense areas, which would result in lower costs (Furlong and Mehay 1981: 55).

Research Question

Since research on the relationship between law enforcement expenditures and crime rates is limited in a Canadian local government context, this research paper was developed with the intention of answering the question, “What statistical impact do law enforcement expenditures have on the municipal crime rate?” An analysis of this question will provide conclusions regarding the relationship between the two variables and how potential changes in a municipality’s police services expenditures will change the crime rate of that particular municipality.

Hypothesis

Based on the theories, concepts and findings identified within the literature review it may be reasonable for a hypothesis anticipating a significant relationship between law enforcement expenditures and per capita crime rates to be presented. Although, due to the often conflicting findings on such a relationship, it may also be reasonable to hypothesize that there is not a significant relationship between law enforcement expenditures and per capita crime rates. Given this lack of agreement in past studies, and the prevalence of economic literature supporting the 'economics of crime' theory the following hypothesis is put forth: A significant relationship exists between law enforcement expenditures and per capita crime rate. Broken-down further, this hypothesis suggests: (1) law enforcement expenditures will have a negative impact on per capita crime rates, and (2) law enforcement expenditures will have a lesser impact on the violent crime rate than on the property crime rate.

These hypotheses suggest that any changes in law enforcement expenditures will result in changes in the per capita crime rate of a municipality. Furthermore, given the expected negative impact, large increases in spending would cause higher average decreases or lower average increases in the crime rate, whereas large decreases in spending would cause higher average increases or lower average decreases in the crime rate.

Methodology

City Selection

This study uses data from 65 municipalities representing nine provinces across Canada. In order to be accepted into the data-set each municipality was required to have a local police force, a population over 15,000 residents, and full access to data relating to the utilized statistical variables. Municipalities such as Rothesay, Joliette, Roussillion, Hamilton, Waterloo, etc. that are enforced by regional police forces were excluded from the data-set. These municipalities were not included because law enforcement expenditure and crime rate data would not adequately align with the municipal data used in the control variables. This is because regional police forces often enforce areas well outside the boundaries of a given municipality. Furthermore, municipalities enforced by provincial police were not included in the analysis because the law enforcement expenditures were determined by the provincial government and not the municipality itself. This exclusion is particularly relevant for municipalities such as Collingwood, Caledon, Kingsville, etc. in Ontario that utilize the Ontario Provincial Police, and also for all municipalities in Newfoundland where law enforcement is the responsibility of the Royal Newfoundland Constabulary and there are no municipal police forces (Statistics Canada, Police Resources in Canada 2008: 32). Lastly, several municipalities employ the services of the Royal Canadian Mounted Police, and are thus ineligible for inclusion in the data-set. Hence several municipalities from Western Canada such as Lloydminster, Red Deer, Burnaby, etc. are excluded from the analysis. A list of the 65 municipalities is included within Appendix 1.

Municipalities with a population of over 15,000 residents (according to the 2001 & 2006 Censes of Population) were considered for inclusion in the analysis, provided they meet the other previously-stated criteria. The one exception was the inclusion of

Summerside, Prince Edward Island, which had a population of 14,654 citizens in 2001 and 14,500 in 2006. This inclusion was deemed necessary to ensure an adequate representation of Prince Edward Island within the analysis, and is acceptable due to the relative proximity of the data to the minimum acceptable population. Other municipalities that did not meet the criteria within both of the Censes of Population were withheld from the analysis.

Lastly, full access to data dealing with the utilized statistical variables must have been realized in order for a municipality to be included in the data. If any data was not present within the Police Resources in Canada reports or the UCR2- Incident Based Survey for the required variables than the corresponding municipality was excluded. Eleven municipalities in Quebec had their municipal per capita law enforcement expenditures excluded from the 2001 Police Resources in Canada report, because in 2001 the corresponding police services enlarged their jurisdictions as a result of municipal amalgamations (Statistics Canada, Police Resources in Canada 2002: 40). Thus, 2001 police resources and crime statistics for these municipalities were deemed inappropriate. Impacted municipalities included Gatineau, Levis, Quebec City, and several other large cities.

Independent, Dependent, and Control Variables

The independent variable for the study will be the per capita law enforcement expenditures for each municipality. This is used as the independent variable so that its impact on the crime rate can be analyzed, by forming conclusions on the relationship between the variables. Furthermore, this independent variable can be used to develop understandings as to how police levels as a whole impact on crime rates. This is because the majority of law enforcement expenditures are directed towards increasing

or decreasing police levels, such as the number of officers employed within a given municipality.

The dependent variable is the crime rate per 100,000 population in each of the municipalities included in the study. The crime rates used as the dependent variable will take three separate forms: (1) all incidents, (2) violent crime, and (3) property crime. The data for all incidents is an accumulation of every incident that a police service reports that fits the definition of a criminal incident. The Reporting Manual produced by the Canadian Centre for Justice Statistics for the Uniform Crime Reporting Incident-Based Survey states that, “the fundamental characteristic of an incident is that it may involve several victims, several accused persons and several different violations of the law. All of these different elements will be grouped together into one incident if they meet the conditions outlined [in the report]”. Furthermore, “the primary rule in determining the number of incidents is based on the violation type. As in the aggregate survey, traffic and non-traffic violations are to be scored as separate incidents”. Lastly, “two or more violations of the law are grouped into the same unique incident if and only if they are committed by the same person or group of persons” and they meet a given set of criteria (2008: 21). Under these guidelines, the all incident crime rate includes crimes against property (property crime), crimes against the person (violent crime), traffic violations, and other incidents that can be labeled as Criminal Code, federal statute, or provincial statute violations.

The data related to the rate of violent crime involve, “offences that deal with the application, or threat of application, of force to a person. These include homicide, attempted murder, various forms of sexual and non-sexual assault, robbery and abduction” (Canadian Centre for Justice Statistics, Uniform Crime Reporting Survey: Concepts and Definitions: 1). The data related to the rate of property crime includes “unlawful acts with the intent of gaining property but do not involve the use or threat of

violence against an individual Theft, breaking and entering, fraud and possession of stolen goods are examples of property crimes" (1). These three forms of crime rate are calculated separately and compared, because literature has suggested that violent crime rates may react differently than property crime rates when changes in law enforcement expenditures occur, due to the offender's likelihood of calculation the opportunity cost of his/her actions prior to committing an offense.

Several variables have been identified as having a possible effect on municipal crime rates, and thus are to be included as control variables. These variables are to be held constant so that any potential relationship between law enforcement expenditures and crime can be identified and verified. The control variables are conventional in relation to those found in previous studies and include: a municipality's total population, population density, median income, percent unemployment, percent males aged 15-24, and percent minority. Due to a reliance on data produced from the most recent Census of the Population, data relating to each of the control variables was only represented in 2001 and 2006.

Population and population density were included as control variables due to the significant variation of each variable found within municipalities included in the study. In order to ensure an adequate sample sized for analysis the range in population and density is significant.

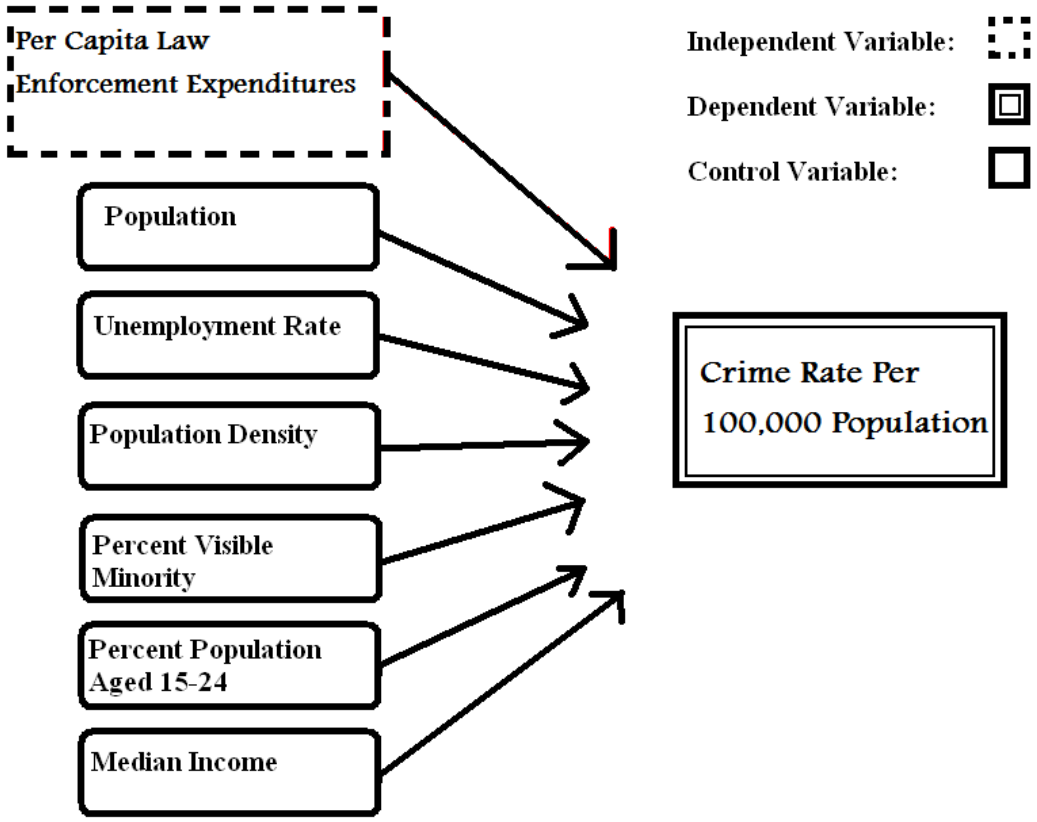
Median income refers to the amount of income which divides the income size distribution of persons aged 15 years and over into two halves. In determining the median income, the following sources of finances were included: "(1) wages and salaries, (2) net farm income, (3) net non-farm income from unincorporated business and/or professional practice, (4) child benefits, (5) Old Age Security pension and Guaranteed Income Supplement, (6) benefits from Canada or Quebec Pension Plan, (7) benefits from Employment Insurance, (8) other income from government sources, (9)

dividends, interest on bonds, deposits and savings certificates, and other investment income, (10) retirement pensions, superannuation and annuities, including those from RRSPs and RRIFs, (11) and other money income" (Statistics Canada, Community Profiles 2006).

The percent unemployed refers to persons aged 15 years and over, who were without paid work or without self-employment work, were available for work and either: (1) actively looked for paid work in the past four weeks, (2) were temporarily laid off and expected to return to their job, or (3) had definite arrangements to start a new job in four weeks or less (Statistics Canada, Community Profiles 2006). Percent unemployed is to be included as a variable due to the positive relationship between unemployment and crime found within Canadian-based studies.

The percent of the population that is male aged 15-24 and the percent of the population that is minority or non-white are included as municipal demographic characteristics because it is expected that crime will vary depending on their levels. In order to be recognized as a visible minority, a citizen must meet the criteria of the *Employment Equity Act*, which defines visible minority as 'persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour' (Statistics Canada, Community Profiles 2006).

Figure 1: Causal Model of Crime Rates



Data Collection

All data on the variables and municipalities was collected in a way that ensures validity and consistency in the numbers utilized throughout the research. This means only credible data sources are to be used. Furthermore, the calendar year (January 1 to December 31) was used as a reference period for all data within the analysis involving crime rates and law enforcement expenditures.

Crime rate statistics for all incidents of crime, violent crime, and property crime were collected from the Uniform Crime Reporting Survey (UCR), as compiled by the Canadian Centre for Justice Statistics. The most recent data-set (2008) was utilized to access UCR data from 2000-2001 and 2005-2006. This data is accurate and credible

because the Canadian Centre for Justice Statistics collects police-reported crime statistics using the UCR Survey, which measures the incidence of crime in Canadian society and its characteristics. As survey response is mandatory for each municipal police service, the response rate in terms of police respondents complying with the UCR Survey is nearly 100 percent (as described by Statistics Canada at http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3302&lang=en&db=imdb&adm=8&dis=2).

Per Capita Police expenditure data was collected from the *Police Resources in Canada* documents from 1999-2008. These documents are released annually by Statistics Canada and report on police personnel and expenditures for Canadian municipal police services. The per capita costs represent operating expenditure data, divided by the population of the area serviced by the police service. The operating expenditure data is comprised of salaries, wages, benefits, operating expenses paid from the police service budget, and benefits paid from other government sources. Costs related to a police service's capital expenditures were excluded from the data (Statistics Canada, Police Resources in Canada 2008: 50). The time period covered by the data was from 1998-2007. Caution was taken in the analysis of this data as several items which may be included within the operational budget of one police service may have been included in the capital budget by other police services. However, it was determined that the differences between such financial allocations would have minimal impact upon the analysis.

Data relating to a municipality's population, population density, median income, percent unemployed, percent males 15-24, and percent minority was collected from the 2001 and 2006 Community Profiles, as published by Statistics Canada. These profiles present community-level information from the 2001 and 2006 Censes of Population. The data relating to a municipality's total population, population density, percent males 15-

24, and median income were collected using 100% sample data, while the data relating to the percent minority and percent unemployed was calculated using a 20% sample data (as described within http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/index.cfm?Lang=E).

Statistical Analysis Techniques

Having accumulated the data for each of the independent, dependent, and control variables, they are to be used in such a way that provides a valid and reliable analytical test of the research question and its accompanying hypothesis. An adequate analysis will take the form of a univariate, bivarate, and multivariate analysis.

Univariate Analysis

A univariate analysis will be conducted to describe the data from each individual variable. It will analyze each variable in from the data set separately, and look at the range of values and central tendency of these values. This will describe the pattern of response to the variable by analyzing each variable on its own.

The data will initially be inputted into a matrix that incorporates all of the variables into the same table. This ensures that data is easily accessible and has been analyzed effectively. Each variable (independent, dependent, and control variables) will then be separately analyzed through the use of frequency distributions and frequency tables that outline the body of data and provide information regarding the highest, lowest, mean, and median values. This will provide a visual interpretation of the data being used in the bivariate and multivariate analysis, which follows and introduces key trends and data points for each of the main variables.

Bivariate Analysis

A bivariate analysis will be used to summarize the associations between the independent variable and the dependent variables, as well as between each separate control variable and the dependent variable. Such an analysis will utilize a correlation matrix. To examine these relationships between variables Pearson correlation coefficients will be used, as they are sensitive to possible linear relationships between two variables.

The Pearson correlation coefficient will indicate the amount of variation in the dependent variable associated with the independent variable. Relationships will be assessed using measures ranging from 1.00 to -1.00, where an *r* equal to 1.00 indicates a direct relationship, an *r* equal to -1.00 indicates an inverse relationship, and an *r* equal to 0.00 indicates a null relationship. By submitting the data from the independent or control variables into the equation along with the data from the dependent variable it is possible to determine how associated the variables are with each other. A correlation between law expenditures and the crime rate close to 0.00 would suggest that the hypothesis is invalid, whereas a correlation closer to 1.00 may suggest the hypothesis is likely (although multivariate analysis would have to take place). It should be noted that, while bivariate analysis will show the correlations between the independent variables and the dependent variable, it will not simultaneously allow for any inclusion of the control variables into the equation.

Multivariate Analysis

The multivariate analysis will take the form of a multiple-regression statistical analysis. The reason that multiple regression is used—where the independent and the control variables are placed into the same equation—is so that the impact of the control

variables can be accounted for in finding how law enforcement expenditures impact on crime rate. In order to understand if an absolute relationship exists, the following regression equation will be used:

$$Y=a + b_1X_1 + b_2X_2 + b_3X_{3....} + b_7X_7$$

where:

Y= dependent variable (crime rate for: all incidents, violent crime, property crime

a = constant

b1= regression coefficient for X1, associated with Y, while controlling for X2, through X7 (control variables include: total population, population density, percent visible minority, percent male aged 15-24, percent unemployed, and median income)

X1= independent variable (per capita law enforcement expenditures)

This equation will be used for six separate regression calculations testing the existence of an absolute relationship. The following simplified versions of this equation will be calculated using data from both 2001 and 2006 (where “spending” is used to describe the per capita law enforcement expenditures):

1. All Incidents = Spending + Controls
2. Property Crime = Spending + Controls
3. Violent Crime = Spending + Controls

In order to understand how accurate the predictions of the multiple regression equation were, it is necessary to analyze R^2 (a multivariate measure of association). This calculation will “indicate the degree of variation in the dependent variable explained by the model, that is, the independent variables included in the equation” (O’Sullivan, Rassal, and Berner 2008: 441). If there is little variation in R^2 as more variables are included in the analysis then it can be found that per capita law enforcement expenditures have an impact on crime rate. If there is significant variation in R^2 then it

can be found that the control variables create much of the changes in a municipalities crime rates.

The key indicator of the relationship between each of the independent variables and the dependent variables is the significance level. The significance level is the conditional probability that a relationship as strong as the one observed would be present, if the null hypothesis were true. For the most part, a value of less than 0.05 is considered significant. An in-depth analysis of the significance level for both the independent variable and the control variables will take place, in order to understand the nature of the relationship between them and the dependent variables.

While the above equations are a good measure for testing the existence of an absolute relationship, they do not account for simultaneity. Simultaneity must be taken into account because it is possible that law enforcement expenditures could not only influence crime rates, but could themselves be affected by crime rates. Furthermore, “a ‘reverse causation’ of crime rates leading to additional police might counteract an impact of police on crime” (Marvell and Moody 1996: 631). As this could have a significant impact on the absolute relationships analyzed through the previous regression calculations, measures must be taken to account for simultaneity.

It has been determined that the use of lags between law enforcement expenditures and crime rates will be used to avoid specification problems involving simultaneity instead of using 2SLS. Though in keeping with much of the recent work completed by Marvell and Moody (1996), Kovandzik and Sloan (2002) and Worrall and Kovandzik (2002), the Granger test for causal direction is not included in the analysis. The lag technique eliminates the simultaneity problem because changes in police expenditures are used to explain later changes in crime rates. Also, it has been determined that several lag lengths should be calculated in order to ensure an adequate analysis is applied to the data. Therefore, calculations will be used in which expenditures

have been lagged by both one and two periods, and also by a double lag period. Using the same basic regression equation as before, the following regressions will be calculated using data from both 2001 and 2006 (2001 is used in the equation examples below):

1. One Period Lag→ ∆All Incidents 2000-2001 = ∆Spending 1999-2000 + 2001 Controls
2. Two Period Lag→ ∆All Incidents 2000-2001 = ∆Spending 1998-2009 + 2001 Controls
3. Double Lag→ ∆All Incidents 2000-2001 = ∆Spending 1998-2000 + 2001 Controls

These equations will also be completed for both Property Crime and Violent Crime.

Analysis

Univariate Analysis

(Table 1) Frequency Chart: 2001 & 2006 Crime Rates

	Mean	Median	Minimum	Maximum
2006 All Incidents	8312.98	7808.00	2340 (Lasalle)	19553 (Victoria)
2006 Crimes of Violence	879.02	820.00	160 (Oak Bay)	1830 (Saskatoon)
2006 Property Crime	3815.28	3407.00	1087 (Lasalle)	10748 (Victoria)
2001 All Incidents	8838.74	8363.00	3019 (Lasalle)	22080 (Victoria)
2001 Crimes of Violence	932.23	877.00	185 (Blainville)	2376 (Victoria)
2001 Property Crime	4306.94	3742.00	1619 (Amherstburg)	11614 (Victoria)

Table 1 provides a look at the range of values and central tendency for the crime rate per 100,000 population for each of the categories of dependent variable. From this output it can be seen that there is significant variation in the range of crime rates for all incidents, violent crime, and property crime. It is clear that the crime rates across Canada for 2006 have been reduced significantly from the rates in 2001. This is seen by a reduction in the mean value of 525.76 crimes per 100,000 for all incidents, a reduction of 53.21 for violent crimes, and 491.66 for property crimes. Similar reductions are also presented in the median data for each category of crime rate. Furthermore, the minimum and maximum crime rates for individual municipalities have all decreased between 2001 and 2006 meaning reductions have not been confined to municipalities close to the mean, but have been consistently noticed across both extremes.

(Table 2) Frequency Chart: 2001 Control Variables

	Mean	Median	Minimum	Maximum
2001 Per Capita Expenditures	166.29	160.00	96 (Cobourg)	294 (Victoria)
2001 Population	154326.34	44121.00	14654 (Summerside)	2481494 (Toronto)
2001 Population Density	947.4708	612.4000	14.80 (Timmins)	5590.80 (Montreal)
2001 Median Income	22891.2000	22145.0000	16923.00 (Miramichi)	33396.00 (Lasalle)
2001 Percent Unemployed	7.0262	7.0000	3.60 (Lasalle)	14.20 (Miramichi)
2001 Percent Males 15-24	6.7431	6.7000	4.00 (Sarnia)	8.30 (Saint-Georges)
2001 Percent Minority	7.5554	3.8000	.20 (Riviere-du-Loop)	49.00 (Vancouver)

(Table 3) Frequency Chart: 2006 Control Variables

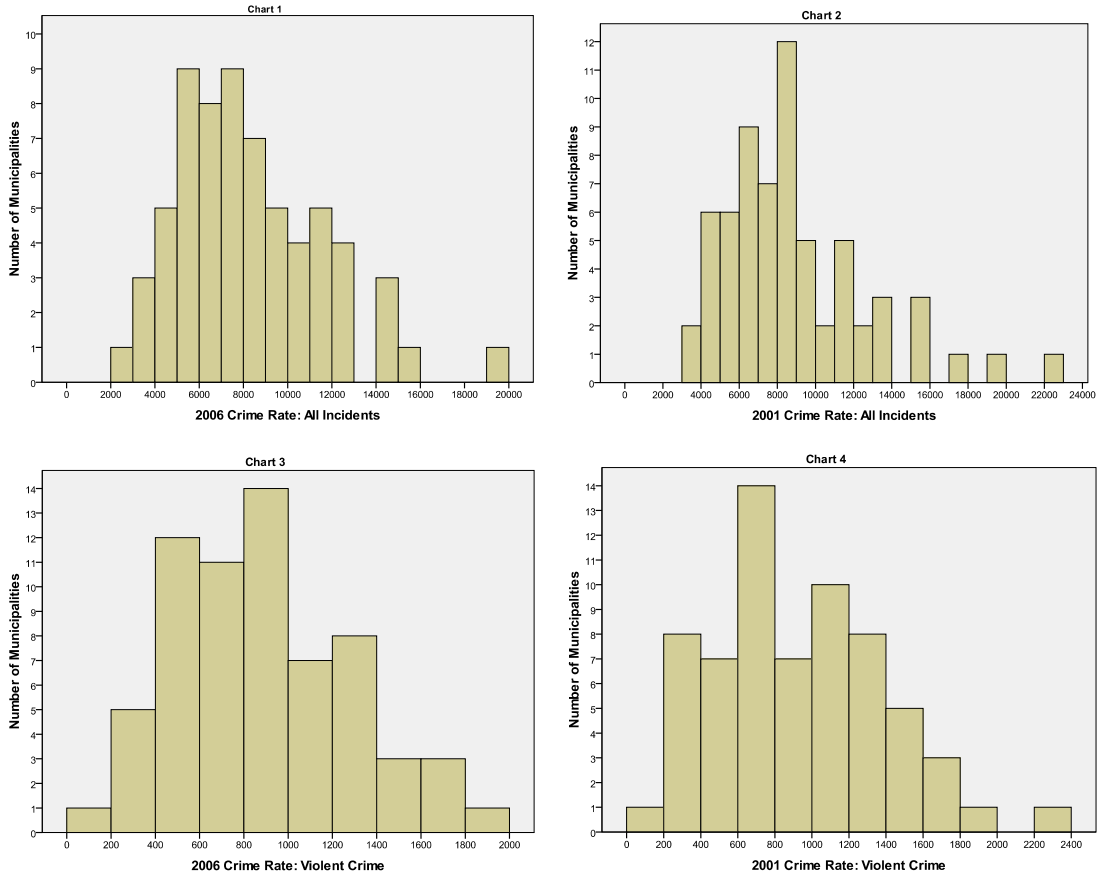
	Mean	Median	Minimum	Maximum
2006 Per Capita Expenditures	218.32	210.00	123 (Mirabel)	344 (Victoria)
2006 Population	171263.06	46493.00	14500 (Summerside)	2503281 (Toronto)
2006 Population Density	931.8338	560.3000	14.50 (Timmins)	5039.00 (Vancouver)
2006 Median Income	26546.9077	26073.0000	20993.00 (Miramichi)	36421.00 (Oak Bay)
2006 Percent Unemployed	6.2477	6.0000	3.10 (Central Saanich)	12.50 (Miramichi)
2006 Percent Males 15-24	6.7754	6.8000	5.30 (New Westminster)	8.50 (Saskatoon)
2006 Percent Minority	9.1369	4.6000	.20 (Saint-Georges)	51.00 (Vancouver)

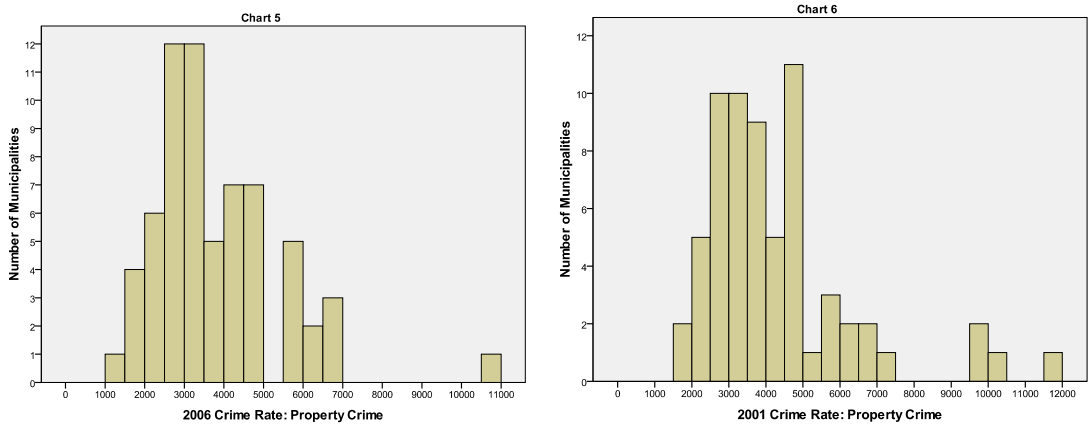
Data from Table 2 and 3 show the extent of the range between municipalities for each of the control variables. With the exception of the percentage of the population that is male aged 15-24, all of the control variables show considerable difference between their respective minimum and maximum values. The most significant range is associated with population density, which notices a difference of 5576 population/km range in 2001 and a 5024.5 population/km range in 2006. Furthermore, the differences between the mean and median for both population and population density are quite significant, therefore emphasizing the sensitivity of the mean in relation to values at either of the extremes.

When comparing Tables 2 and 3 it is noteworthy that the average population has increased. The average population density of Canadian municipalities has decreased.

Furthermore, the median income has increased by an average of $3655.71 from 2001 to 2006, while the percent of the population that is non-white or visible minority has increased by 1.58 percent. On the other hand, there has been relatively no change between the average percent of the population aged 15-24 or the percent of the population that is unemployed.

As seen in Charts 1 to 6, municipalities have experienced a considerable decrease in the rate of crime when accounting for all incidents, violent crime, and property crime.





As evidence of the decrease in the rate of crime, in 2001 the most frequent grouping of crime rate was 8,000-9,000 crimes per 100,000 population with twelve municipalities falling within this group (Chart 2). On the other hand, in 2006 the most frequent grouping of crime rates was between 5,000-6,000 and 7,000-8,000 crimes per 100,000 population, with nine municipalities falling within each group (Chart 1). Similarly, in 2001, the property crime rate grouping that occurred most frequently was between 4,500-5,000 crimes per 100,000 population, with eleven municipalities falling within this group (Chart 6). However, by 2006, the property crime rate grouping with the highest frequency was between 2,500-3,000 and 3,000-3,500 crimes per 100,000 population, with a total of twelve municipalities falling within each group (Chart 5). In terms of violent crime, the shift towards lower crime rates is evident because 28 municipalities had a violent crime rate above 10,000 crimes per 100,000 population in 2001 (Chart 4), while this number had fallen to 22 municipalities in 2006 (Chart 3).

Bivariate Analysis

(Table 4) Correlations: 2001 Data

		2001 All Incidents	2001 Crimes of Violence	2001 Property Crime
2001 Per Capita Expenditures	Pearson Correlation	.594**	.614**	.582**
	Sig. (2-tailed)	.000	.000	.000
2001 Population	Pearson Correlation	.024	.138	.116
	Sig. (2-tailed)	.852	.272	.356
2001 Population Density	Pearson Correlation	.366**	.315*	.513**
	Sig. (2-tailed)	.003	.011	.000
2001 Median Income	Pearson Correlation	-.327**	-.384**	-.273*
	Sig. (2-tailed)	.008	.002	.028
2001 Percent Unemployed	Pearson Correlation	.349**	.456**	.277*
	Sig. (2-tailed)	.004	.000	.025
2001 Percent Males 15-24	Pearson Correlation	.151	.076	.163
	Sig. (2-tailed)	.230	.549	.194
2001 Percent Minority	Pearson Correlation	.210	.132	.387**
	Sig. (2-tailed)	.092	.295	.001

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

With none of the variables under control, the data produced in Table 4 shows that, in 2001, there was a high positive correlation between per capita expenditures and each form of crime rate with all relationships being significant at the 0.01 level in a two-tailed test. Of these forms, the most significant correlation occurred between per capita expenditures and the crime rate for crimes of violence, where the Pearson correlation was found to be .614. This suggests that a municipality with high law enforcement expenditures is more likely to have a high crime rate than a municipality with low expenditures. The control variables do not show such high correlations with the dependent variables although several are found to be significant. Population is found to have the weakest correlation of all the control variables. The percent of the population that is male, aged 15-24 is also insignificant. Interestingly, the percentage of the

population that is minority or non-white is found to be statistically insignificant for the crime rates of all incidents and crimes of violence, but is found to be significant in relation to property crime at the 0.01 level (.387 Pearson correlation). Population density has a high positive correlation with the all incidents and property crime variables, and the correlation with violent crime is found to be highly significant. The percent of the population that is unemployed also shows fairly strong positive correlations with all of the dependent variables, and it is strongest with violent crime. Lastly, median income was the only variable to be negatively related to the dependent variables, showing that a municipality with high a high median income is more likely to have low crime rates than a municipality with a low median income.

(Table 5) Correlations: 2006 Data

		2006 All Incidents	2006 Crimes of Violence	2006 Property Crime
2006 Per Capita Expenditures	Pearson Correlation	.626**	.669**	.605**
	Sig. (2-tailed)	.000	.000	.000
2006 Population	Pearson Correlation	.068	.124	.149
	Sig. (2-tailed)	.588	.327	.235
2006 Population Density	Pearson Correlation	.418**	.332**	.486**
	Sig. (2-tailed)	.001	.007	.000
2006 Median Income	Pearson Correlation	-.376**	-.475**	-.302*
	Sig. (2-tailed)	.002	.000	.015
2006 Percent Unemployed	Pearson Correlation	.182	.341**	.103
	Sig. (2-tailed)	.147	.005	.413
2006 Percent Males 15-24	Pearson Correlation	.207	.153	.203
	Sig. (2-tailed)	.098	.224	.105
2006 Percent Minority	Pearson Correlation	.220	.109	.332**
	Sig. (2-tailed)	.079	.386	.007

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The correlations for 2006 maintain mostly similar traits to those presented in 2001, although important differences are present. The positive correlation between per capita expenditures and each of the dependent variables has increased, although the

increase for each of the variables is only marginal. Population continues to have the weakest correlation with the dependent variables when compared to the remainder of the control variables. The percentage of the population that is within the category of minority or non-white has remained consistent with the data found in 2001, with the only significant correlation occurring in relation to property crime. The percent of the population that is male, aged 15-24 continues to be insignificant, although the absolute values presented by the Pearson correlation have all shifted towards producing stronger correlations. The population density of a municipality has become more statistically significant in relation to crimes of violence (the correlation is significant at the 0.01 level). Conversely, the percent of the population that is unemployed has seen considerable change in its relation to the all incident and property crime rates, where the correlations are no longer seen as significant at any level, though it remains significantly related with violent crime. Finally, the median income continues to be the only control variable that has a negative correlation with the dependent variables, and by 2006 this correlation had become stronger for each of the dependent variables.

Multivariate Analysis

Multiple-regression calculations—in the form of linear regression—were completed to test if there was an absolute relationship between law enforcement expenditures and the crime rate, while controlling for other variables. The outputs of these calculations can be found in Tables 6-11.

(Table 6) Regression: 2001 All Incidents

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	-607.657	6652.136	.928
	2001 Per Capita Expenditures	52.013	11.646	.000
	2001 Population	-.004	.001	.006
	2001 Population Density	.979	.481	.046
	2001 Median Income	-.241	.145	.103
	2001 Percent Unemployed	-45.997	247.736	.853
	2001 Percent Males 15-24	914.746	494.756	.070
	2001 Percent Minority	19.315	65.147	.768

a. Dependent Variable: 2001 All Incidents
b. Adjusted R Square: 0.463

As Table 6 shows, the adjusted R^2 for the 2001 all incident crime rate data found that the predictors explained 46.3% of the variation in the crime rate. Furthermore, the 2001 per capita law enforcement expenditures were found to be significant at the 0.001 level, suggesting that there is a high absolute relationship between the variables. However, it is not possible to reject the null hypothesis based on this data because the regression calculations have not yet accounted for simultaneity. Such a relationship could be possible due to the potential influence of crime rates on per capita expenditures.

The 2001 control variables were not as significant when compared to the per capita law enforcement expenditures variable. It is seen that population is the only control variable to be significant at the 0.01 level, while population density is the only other variable to be significant below the 0.05 level. However, the percent of the population that is male, aged 15-24 is almost significant, having achieved a 0.07 significance value. Conversely, median income, the percent unemployment and the percent of the population that are minority or non-white do not have significant relationships with the all incident crime rate, with unemployment (0.853 significance) and

percent minority (0.768 significance) having almost no significance in their respective relationships.

(Table 7) Regression: 2001 Violent Crime

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	-403.030	822.369	.626
	2001 Per Capita Expenditures	6.861	1.440	.000
	2001 Population	-2.593E-5	.000	.881
	2001 Population Density	.072	.059	.230
	2001 Median Income	-.017	.018	.340
	2001 Percent Unemployed	26.825	30.626	.385
	2001 Percent Males 15-24	62.345	61.164	.312
	2001 Percent Minority	-11.045	8.054	.176

a. Dependent Variable: 2001 Crimes of Violence
b. Adjusted R Square: 0.438

The regression calculations involving violent crime rate data for 2001 show considerably different significance levels between the predictors and the dependent variable when compared to the all incident crime rate data for 2001, as seen in Table 7. Where the all incident regression calculations showed several control variables that had significant levels below or near the 0.05 level, the violent crime regression calculations did not have any control variables that are significant within this level. This suggests the economic model is weaker in explaining crimes of violence. However, when it comes to violent crime, the per capita expenditures continue to be highly significant.

(Table 8) Regression: 2001 Property Crime

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	916.838	3294.416	.782
	2001 Per Capita Expenditures	19.852	5.768	.001
	2001 Population	-.003	.001	.001
	2001 Population Density	.723	.238	.004
	2001 Median Income	-.155	.072	.035
	2001 Percent Unemployed	-76.532	122.689	.535
	2001 Percent Males 15-24	511.236	245.024	.041
	2001 Percent Minority	58.370	32.263	.076

a. Dependent Variable: 2001 Property Crime
b. Adjusted R Square: 0.525

The 2001 property crime regression results found in Table 8 show that the control variables have much more significance in their relationship with the dependent variable than they did for either the all incident or violent crime rate variables. Property crime is similar in that the per capita law enforcement expenditures continue to be highly significant at the 0.001 level. However, all of the control variables—with the exception of percent unemployment and percent of the population that are minority or non-white—are significant at the 0.05 level or better. Furthermore, the percent minority is close to being significant. Perhaps telling of these significance levels for the dependent variables is the fact that the adjusted R^2 for the property crime regression calculation explains over half of the variation, at 0.525.

(Table 9) Regression: 2006 All Incidents

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	-3568.717	5265.122	.501
	2006 Per Capita Expenditures	28.545	7.142	.000
	2006 Population	-.003	.001	.006
	2006 Population Density	1.726	.423	.000
	2006 Median Income	-.266	.099	.009
	2006 Percent Unemployed	36.811	201.817	.856
	2006 Percent Males 15-24	1723.272	454.277	.000
	2006 Percent Minority	-34.883	42.553	.416

a. Dependent Variable: 2006 All Incidents
b. Adjusted R Square: 0.580

In 2006, all incident crime rate data results in several points when evaluated against the data in 2001, upon the completion of a multiple-regression calculation, as shown in Table 9. First, the adjusted R^2 has increased significantly, indicating that the predictors can be used to explain 58.0 percent of the variation in the crime rate for 2006. Second, the per capita law enforcement expenditures continue to be significant at the 0.001 level, as does the control variable accounting for a municipality's population (which has not changed its 0.06 significance value). Third, population density becomes more significant, and is now at the 0.001 significance level. Fourth, the percent of the population that is unemployed and the percent that is visible minority or nonwhite continue to be statistically insignificant in relation to the all incident crime rate. Finally, both median income and the percent of the population that is unemployed have become significantly related to the dependent variable, which was not the case in 2001.

(Table 10) Regression: 2006 Violent Crime

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	-600.106	603.533	.324
	2006 Per Capita Expenditures	4.567	.819	.000
	2006 Population	-7.912E-5	.000	.495
	2006 Population Density	.141	.049	.005
	2006 Median Income	-.028	.011	.016
	2006 Percent Unemployed	22.190	23.134	.342
	2006 Percent Males 15-24	159.770	52.073	.003
	2006 Percent Minority	-11.818	4.878	.019

a. Dependent Variable: 2006 Crimes of Violence
b. Adjusted R Square: 0.608

A comparison of the 2001 and 2006 violent crime regression data results in similar findings to the comparison of the 2001 and 2006 all incident crime regression results. As with the all incident results, the control variables for the violent crime variable become more significant. For example, while no control variables were significant in 2001, by 2006, population density, median income, the percent of the population that is male, aged 15-24, and the percent of the population that is minority or non-white were all significant at the 0.05 level.

(Table 11) Regression: 2006 Property Crime

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	-1566.534	2748.253	.571
	2006 Per Capita Expenditures	12.044	3.728	.002
	2006 Population	-.001	.001	.018
	2006 Population Density	.832	.221	.000
	2006 Median Income	-.118	.052	.026
	2006 Percent Unemployed	-20.480	105.343	.847
	2006 Percent Males 15-24	804.950	237.120	.001
	2006 Percent Minority	.673	22.211	.976

a. Dependent Variable: 2006 Property Crime
b. Adjusted R Square: 0.527

The 2006 property crime regression results are almost identical to the 2001 results in that all of the control variables except unemployment and percent minority are

significant at the 0.05 level. However, though the percent of the population that are minority or non-white was close to being significant in 2001 (0.076 significance), by 2006 the variable had become completely insignificant (0.976 significance) in its relationship with the dependent variable.

Without the use of lagged variables, the data suggests that per capita law enforcement expenditures have a positive absolute relationship with the crime rates for all incidents, violent crime, and property crime. This means that higher per capita expenditures are associated with higher crime rates, although it does not suggest which variable impacts more greatly on the other. The control variables, on the other hand do not maintain similar relationships between the different dependent variables.

Population has a negative absolute relationship with all of the dependent variables, however such a relationship is much more negative for the all incident and property crime rates, most likely because population is significantly related to them and not violent crime. This would suggest that, when controlling for other variables, a municipality with a high population could expect a lower crime rate than a municipality with a lower population. This is in contrast to some of the literature, which suggested that urban communities are more likely to have higher crime (Buck et al. 1983: 481). Furthermore, by not being significant for violent crime, it is apparent that violent crime is just as likely to occur in small municipalities as it is in larger municipalities.

Population density, on the other hand, has a positive relationship with each of the dependent variables. As literature would suggest, this relationship could possibly occur because a municipality with a higher population density would also have a larger stock of criminals, due to increased interactions among people. This increased stock of criminals would lead to criminal activity (Buck et al. 1983: 477).

While the median income variable is not significant in relation to the all incident and violent crime rates in 2001, it is significant for 2001 property crime and all types of

crime in 2006. Furthermore, the relationship with all of these dependent variables is highly negative. This is in contrast to the findings of Avio and Clark (1978) who suggested that areas with high average incomes would likely have higher crime rates than areas with low average incomes because of the larger amounts of property available for illegal transfers (8). However, what this variable could suggest is that municipalities with high median incomes will have less crime because citizens are less likely to need to resort to crime in order to live as it is more likely that their financial needs are being met. It is unclear why the variable is not significant in relation to the all incident and violent crime rate in 2001, but is significant in 2006.

Similar to the median income control variable, the percent of the population that is male, aged 15-24 is not significant in relation to the all incidents and violent crime rates in 2001, but is significant for 2001 property crime and all types of crime in 2006. Also, it is unclear why a change in significance occurred between 2001 and 2006, although it is possible that changes in youth culture or ineffective social programs led to an increased likelihood that young males would commit crimes. Unlike the median income variable, the population of males aged 15-24 variable is positively related to the crime rate. The positive relationship between the control variable and the dependent variables suggests that municipalities with a high percentage population of males between the ages of 15 and 24 will have a higher crime rate than municipalities with low percent population of young males. This confirms the findings in American data that show this age group being associated with high crime rates (Marvell and Moody 1996: 625). However, it conflicts with other Canadian data that found this age group to be statistically insignificant for all crimes except break and enter (Avio and Clark 1978: 13).

The percent of municipality's population that is minority or non-white is only significant for violent crime in 2006. At this time it has a negative relationship with the violent crime rate. The lack of significance between the control variable and the

dependent variables confirm the idea that minorities tend to be socially well integrated. The fact that a negative relationship existed with violent crime in 2006 suggests that municipalities with a high percentage of minority population may, in fact, experience lower levels of violent crime than municipalities with low minority populations.

Multivariate Analysis with Lagged Variables

The use of lags between law enforcement expenditures and crime rates were used to avoid specification problems involving simultaneity. Through the use of one, two, and double year lags, changes in police expenditures were used to explain later changes in crime rates. The results for all incident crime rates in 2001 and 2006 are presented below.

(Table 12) Regression: All Crime 1 Year Lag--2001

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	.083	.216	.701
	Change Expenditures 1999-2000	-.182	.163	.268
	2001 Population	-1.980E-8	.000	.673
	2001 Population Density	-2.274E-5	.000	.153
	2001 Median Income	-4.257E-6	.000	.386
	2001 Percent Unemployed	-.007	.008	.383
	2001 Percent Males 15-24	.008	.016	.630
	2001 Percent Minority	.004	.002	.062

a. Dependent Variable: Change All Crime 2000-2001
b. Adjusted R Square: 0.002

(Table 13) Regression: All Crime 2 Year Lag--2001

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.093	.218	.670
	Change Expenditures 1998-1999	.056	.115	.626
	2001 Population	-2.394E-8	.000	.612
	2001 Population Density	-2.190E-5	.000	.172
	2001 Median Income	-4.952E-6	.000	.314
	2001 Percent Unemployed	-.007	.008	.389
	2001 Percent Males 15-24	.007	.017	.678
	2001 Percent Minority	.004	.002	.048

a. Dependent Variable: Change All Crime 2000-2001
b. Adjusted R Square: -0.015

(Table 14) Regression: All Crime Double Lag--2001

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.096	.218	.662
	Change Expenditures 1998-2000	-.010	.101	.920
	2001 Population	-2.408E-8	.000	.611
	2001 Population Density	-2.149E-5	.000	.180
	2001 Median Income	-4.931E-6	.000	.318
	2001 Percent Unemployed	-.007	.008	.383
	2001 Percent Males 15-24	.007	.017	.686
	2001 Percent Minority	.004	.002	.046

a. Dependent Variable: Change All Crime 2000-2001
b. Adjusted R Square: -0.019

(Table 15) Regression: All Crime 1 Year Lag--2006

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.165	.262	.531
	Change Expenditures 2004-2005	.275	.249	.273
	2006 Population	-3.650E-9	.000	.942
	2006 Population Density	-1.087E-5	.000	.589
	2006 Median Income	-8.001E-7	.000	.873
	2006 Percent Unemployed	-.002	.010	.815
	2006 Percent Males 15-24	-.015	.023	.500
	2006 Percent Minority	-.002	.002	.330

a. Dependent Variable: Change All Crime 2005-2006
b. Adjusted R Square: 0.005

(Table 16) Regression: All Crime 2 Year Lag--2006

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.184	.264	.489
	Change Expenditures 2003-2004	.162	.220	.464
	2006 Population	-5.342E-9	.000	.915
	2006 Population Density	-1.056E-5	.000	.602
	2006 Median Income	-7.725E-7	.000	.878
	2006 Percent Unemployed	-.001	.010	.883
	2006 Percent Males 15-24	-.018	.023	.434
	2006 Percent Minority	-.002	.002	.316

a. Dependent Variable: Change All Crime 2005-2006
b. Adjusted R Square: -0.007

(Table 17) Regression: All Crime Double Lag--2006

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.179	.261	.497
	Change Expenditures 2003-2005	.170	.139	.227
	2006 Population	-2.763E-9	.000	.956
	2006 Population Density	-1.096E-5	.000	.585
	2006 Median Income	-9.181E-7	.000	.854
	2006 Percent Unemployed	-.002	.010	.825
	2006 Percent Males 15-24	-.018	.023	.435
	2006 Percent Minority	-.002	.002	.300

a. Dependent Variable: Change All Crime 2005-2006
b. Adjusted R Square: -0.009

* Regression tables with lags for violent and property crime can be found in Appendix 2*

It has been established that a significant positive interrelationship exists between per capita law enforcement expenditures and each of the measured types of crime rates through the bivariate analysis. Furthermore, through the introduction of control variables in a multiple-regression analysis it has been determined that an absolute relationship exists. However, these calculations do not account for simultaneity, and therefore, do not show how or if law enforcement expenditures impact crime. To avoid the problems arising from simultaneity, a series of lags on the independent variable were used to

measure how changes in law enforcement expenditures impact changes in crime rates (changes in the control variables were not calculated). The lags consisted of one year, two year, and a double year period.

As observed in the data produced from the all incident regression equations involving lags, the significance values of law enforcement expenditures suggest that changes in spending have no significant impact on changes in the all incident crime rate. This is clearly the case for the calculations relating to both 2001 and 2006. Also, the data demonstrates that there is no significant relationship between the dependent variable and the control variables (Tables 12-17). This is to be expected because the control variables do not change, but instead act as placeholders within the multiple-regression equation. One cannot expect them to have a relationship with the dependent variable because they do not change in the same manner as the dependent or spending variables. The findings from violent crime and property crime are similar to the all incident lagged regression equations. The results of the lagged regression calculations for violent and property crime can be found in Appendix 2. This means that law enforcement expenditures do not have a significant impact on any of the dependent variables. Furthermore, the data from the bivariate and multivariate analyses without lags may suggest that crime rates instead impact expenditures (analysis on such a conclusion is, however, beyond the scope of this paper).

The finding that per capita law enforcement expenditures do not have a significant impact on crime rates when the independent variable was lagged is in accordance with many of the studies included in the meta-analyses of Marvell, Moody, and Cameron (1988), which concluded that there was often no relationship between police and crime. Furthermore, since the meta-analyses also identified several studies that concluded a positive relationship exists, the significant positive absolute relationship that was found between expenditures and crime when no lags were included in the

calculation is consistent with many of the previously completed analyses on the subject in the United States.

The conclusion that law enforcement expenditures do not have an impact on crime rates is important because it calls portions of the 'economics of crime theory' into question along with an offender's use of cost-benefit analysis in committing crimes. The theory suggests that potential offenders respond to the opportunity costs and gains available to them in legitimate and illegitimate pursuits (Ehrlich 1972: 260). Following this train of thought an increase in police expenditures would lead to decreases in the crime rate (have a negative impact) because of the higher opportunity costs for offenders, which results because higher expenditures generally mean increases in the probability of being caught. However, the data suggests one of three scenarios has the potential to exist in the law enforcement—crime rate relationship.

First, the data potentially suggests that offenders do not make rational choices, in the manner suggested by the 'economics of crime' theory. Instead of making rational choices about whether or not to commit a crime, the offender instead makes choices as to what type of crime they will commit, where they will commit it, and how they will commit it. This is similar to the theory discussed briefly by Marvell and Moody (1996: 610). If this is the case, crimes will continue to be committed as offenders do not rationally act (or not act) upon the increased probability of apprehension. Furthermore, it is also possible that offenders are not acting irrationally by continuing to commit crimes following an increase in police expenditures, but rather that they are ill-informed that such changes in spending have been made, thus continuing their previous patterns of crime.

Second, it is possible that changes in spending do deter offenders from certain types of crime, but instead of decreasing the number of crimes they commit, the offender simply modifies the types of crimes they pursue. While this is unlikely because the data

suggests law enforcement expenditures have no significant impact on crime as whole, violent crime, or property crime, it is possible that offenders change their type of crime while staying within the same category of crime. For example, an offender who usually commits break and enter crimes would convert their deeds to theft related crimes. So while law enforcement expenditures may have had a negative impact on break and entering the result is positive impact on theft—both of which are property crimes. Therefore, it would appear that expenditures do not impact crime, based on the categories of crime used within this analysis.

Third, it is possible that any changes in law enforcement expenditures were not directed towards the right areas of crime deterrence, Instead, law enforcement expenditures could be directed towards poorly developed crime deterrence strategies, or law enforcement tasks that are unrelated to reducing crime (ie. administrative tasks, police wage increases, etc).

While these scenarios of the law enforcement expenditures impact on crime rates may not necessarily be reality, there is potential that one or a combination of two or more exists, although there is no way of accurately testing these scenarios given the available data. What is more likely to be the case, however, is that crime rates are is impacted by other variables such as some of the control variables found in the analysis, or other variables that have not been included. Unfortunately, it is not possible to calculate the impact of each control variable on changes in crime rates given the data used in this analysis because control variable data is not calculated for each of the specific variables on a yearly basis, but is instead calculated following the completion of each Census (once every five years).

Implications for Municipalities

While incorrectly assuming that law enforcement expenditures have a negative impact on crime rates within the community, many municipalities will increase the amount of expenditures allocated to their operating budget. The majority of these expenditure increases are assigned to the salaries that accompany the addition of more police officers. However, the data has shown the increasing law enforcement expenditures has no significant impact on crime rates, even though an absolute relationship exists between the variables. This provides municipalities and their police services the opportunity to reconsider where finances are being directed, without causing a dramatic change in crime rate. Since increases in law enforcement expenditures are unjustified if they do not produce results through their impact on crime rates, by directing finances to other resources or programs that have a significant impact on crime rates, there may be a greater likelihood of developing a formula that creates safer municipalities. For example, median income and the percent of a population that is male, aged 15-24 have a high absolute relationship with several of the crime rate categories. By re-allocating finances from law enforcement to crime deterrence programs, such as assistance programs for male youths and/or the poor, there is potential that crime rates could be impacted.

Conclusion

From the statistical results several conclusions can be inferred, although further studies or analysis may be necessary.

The data has provided no evidence that per capita law enforcement expenditures have a significant impact on crime rates in Canadian municipalities, thus the null hypothesis is found to be true. These findings are pertinent to crime rates involving all incidents, violent crime, and property crime when utilizing data from 2001 and 2006. Through the use of bivariate analysis, expenditures and crime were found to be highly positively correlated. Furthermore, a multivariate analysis utilizing linear regression found there to be a high positive absolute relationship between the variables. However, through the introduction of regression calculations involving lags on the per capita law enforcement expenditure variable, it was found that changes in expenditures do not have a significant impact on changes to the crime rate. This suggests that the absolute relationship between the variables is caused by other factors, and likely by issues relating to simultaneity.

Based on the evidence, the percent of a municipality's population that is unemployed is a poor control variable, as it has no significant absolute relationship with all incidents of crime, violent crime, or property crime. This makes it a poor predictor to be included in a linear-regression model because differences in unemployment are in no way related to crime rates when accompanied by other control variables. On the other hand, control variables such as population, population density, median income, and percent of the population that are male, ages 15-24 were found to be related to crime in most situations. Population density was found to be significant in every circumstance except in its relationship with violent crime in 2001 (violent crime in 2001 was not significantly related to any of the control variables). Income and percent males 15-24

had significant absolute relationships with the dependant variables other than violent crime and all incident crime in 2001. Lastly, population had a significant absolute relationship with all dependant variables, with the exception of violent crime in 2001 and 2006.

There is also reason to believe that the criminal behaviour theory discussed by Ehrlich (1972)—which presents the idea that offenders conduct a cost-benefit analysis based on the opportunity gains (costs) available to them through crime—may not be sound. In theory, a rational offender would recognize the increased likelihood of being apprehended; a likelihood that accompanies the increase in police levels resulting from escalating police expenditures. Since the data provides evidence that crime rates do not decrease due to increases in expenditure, it is viable to suggest that offenders may not conduct such cost-benefit analyses.

Lastly, the analysis provides evidence that municipalities may not be able to justify increasing law enforcement expenditures in attempts to lower their community's crime rate. Instead, it may be more effective to allocate the finances to other areas of the municipality, such as programs or services which could have greater effectiveness in reducing crime.

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Appendix 1

The following municipalities were included within the data-set:

- Abbotsford
- Amherstburg
- Barrie
- Belleville
- Blainville
- Brandon
- Brantford
- Brockville
- Calgary
- Central Saanich
- Charlottetown
- Châteauguay
- Chatham-Kent
- Cobourg
- Cornwall Community Police
- Delta
- Edmonton
- Edmundston
- Essex
- Fredericton
- Granby
- Guelph
- Kingston
- L'Assomption
- Lasalle
- Laval
- Leamington
- Lethbridge
- London
- Mascouche
- Medicine Hat
- Memphremagog
- Midland
- Mirabel
- Miramichi
- Montréal
- Moose Jaw
- New Westminster
- North Bay
- Oak Bay
- Orangeville
- Owen Sound
- Port Moody
- Regina
- Rivière-du-Loup
- Saanich
- Saint John
- Saint-Georges
- Sarnia
- Saskatoon
- Sault Ste. Marie
- Sherbrooke
- St. Thomas
- Stratford
- Strathroy
- Summerside
- Thetford Mines
- Thunder Bay
- Timmins
- Toronto
- Vancouver
- Victoria
- West Vancouver
- Windsor
- Winnipeg

Appendix 2

Regression: Violent Crime 1 Year Lag--2001

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	-.090	.381	.814
	Change Expenditures 1999-2000	-.378	.288	.194
	2001 Population	5.899E-8	.000	.477
	2001 Population Density	-6.792E-6	.000	.807
	2001 Median Income	3.311E-6	.000	.702
	2001 Percent Unemployed	-.007	.014	.606
	2001 Percent Males 15-24	.016	.029	.589
	2001 Percent Minority	-.003	.004	.419

a. Dependent Variable: Change Violent Crime 2000-2001
b. Adjusted R Square: -.056

Regression: Violent Crime 2 Year Lag--2001

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	-.060	.386	.876
	Change Expenditures 1998-1999	-.083	.204	.684
	2001 Population	4.927E-8	.000	.556
	2001 Population Density	-3.673E-6	.000	.896
	2001 Median Income	1.834E-6	.000	.833
	2001 Percent Unemployed	-.007	.014	.599
	2001 Percent Males 15-24	.013	.029	.663
	2001 Percent Minority	-.002	.004	.538

a. Dependent Variable: Change Violent Crime 2000-2001
b. Adjusted R Square: -0.085

Regression: Violent Crime Double Lag--2001

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	-.063	.381	.868
	Change Expenditures 1998-2000	-.228	.176	.201
	2001 Population	5.377E-8	.000	.516
	2001 Population Density	-3.817E-6	.000	.891
	2001 Median Income	2.546E-6	.000	.767
	2001 Percent Unemployed	-.008	.014	.586
	2001 Percent Males 15-24	.014	.029	.642
	2001 Percent Minority	-.003	.004	.492

a. Dependent Variable: Change Violent Crime 2000-2001
b. Adjusted R Square: -0.057

Regression: Property Crime 1 Year Lag--2001

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.242	.279	.391
	Change Expenditures 1999-2000	-.043	.211	.841
	2001 Population	-4.497E-8	.000	.460
	2001 Population Density	-2.436E-5	.000	.236
	2001 Median Income	-5.622E-6	.000	.376
	2001 Percent Unemployed	-.005	.010	.632
	2001 Percent Males 15-24	-.014	.021	.502
	2001 Percent Minority	.005	.003	.084

a. Dependent Variable: Change Property Crime 2000-2001
b. Adjusted R Square: -0.055

Regression: Property Crime 2 Year Lag--2001

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.247	.279	.379
	Change Expenditures 1998-1999	-.052	.147	.723
	2001 Population	-4.630E-8	.000	.444
	2001 Population Density	-2.371E-5	.000	.247
	2001 Median Income	-5.795E-6	.000	.357
	2001 Percent Unemployed	-.005	.010	.625
	2001 Percent Males 15-24	-.015	.021	.487
	2001 Percent Minority	.005	.003	.074

a. Dependent Variable: Change Property Crime 2000-2001
b. Adjusted R Square: -0.054

Regression: Property Crime Double Lag--2001

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.245	.279	.384
	Change Expenditures 1998-2000	-.030	.129	.817
	2001 Population	-4.547E-8	.000	.453
	2001 Population Density	-2.402E-5	.000	.241
	2001 Median Income	-5.694E-6	.000	.367
	2001 Percent Unemployed	-.005	.010	.628
	2001 Percent Males 15-24	-.015	.021	.494
	2001 Percent Minority	.005	.003	.079

a. Dependent Variable: Change Property Crime 2000-2001
b. Adjusted R Square: -0.055

Regression: Violent Crime 1 Year Lag--2006

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.172	.325	.598
	Change Expenditures 2004-2005	-.041	.309	.894
	2006 Population	-2.036E-8	.000	.743
	2006 Population Density	-2.408E-5	.000	.336
	2006 Median Income	-2.249E-6	.000	.716
	2006 Percent Unemployed	.011	.013	.390
	2006 Percent Males 15-24	-.021	.028	.451
	2006 Percent Minority	.002	.003	.527

a. Dependent Variable: Change Violent Crime 2005-2006
b. Adjusted R Square: -0.050

Regression: Violent Crime 2 Year Lag--2006

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.170	.325	.604
	Change Expenditures 2003-2004	-.017	.272	.950
	2006 Population	-2.002E-8	.000	.747
	2006 Population Density	-2.414E-5	.000	.335
	2006 Median Income	-2.260E-6	.000	.715
	2006 Percent Unemployed	.011	.012	.394
	2006 Percent Males 15-24	-.021	.028	.461
	2006 Percent Minority	.002	.003	.527

a. Dependent Variable: Change Violent Crime 2005-2006
b. Adjusted R Square: -0.050

Regression: Violent Crime Double Lag--2006

Model		Unstandardized Coefficients		
		B	Std. Error	Sig.
1	(Constant)	.171	.325	.602
	Change Expenditures 2003-2005	-.015	.173	.932
	2006 Population	-2.021E-8	.000	.745
	2006 Population Density	-2.411E-5	.000	.335
	2006 Median Income	-2.250E-6	.000	.716
	2006 Percent Unemployed	.011	.013	.392
	2006 Percent Males 15-24	-.021	.028	.457
	2006 Percent Minority	.002	.003	.526

a. Dependent Variable: Change Violent Crime 2005-2006
b. Adjusted R Square: -0.050

Regression: Property Crime 1 Year Lag--2006

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	-.133	.265	.618
	Change Expenditures 2004-2005	.351	.252	.170
	2006 Population	5.277E-8	.000	.300
	2006 Population Density	-2.622E-5	.000	.201
	2006 Median Income	7.390E-6	.000	.147
	2006 Percent Unemployed	.014	.010	.165
	2006 Percent Males 15-24	-.021	.023	.374
	2006 Percent Minority	-.001	.002	.533

a. Dependent Variable: Change Property Crime 2005-2006
b. Adjusted R Square: -0.061

Regression: Property Crime 2 Year Lag--2006

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	-.119	.270	.661
	Change Expenditures 2003-2004	.033	.225	.884
	2006 Population	4.869E-8	.000	.346
	2006 Population Density	-2.566E-5	.000	.218
	2006 Median Income	7.592E-6	.000	.143
	2006 Percent Unemployed	.016	.010	.132
	2006 Percent Males 15-24	-.022	.024	.356
	2006 Percent Minority	-.001	.002	.556

a. Dependent Variable: Change Property Crime 2005-2006
b. Adjusted R Square: -0.029

Regression: Property Crime Double Lag--2006

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	-.118	.268	.662
	Change Expenditures 2003-2005	.136	.142	.344
	2006 Population	5.183E-8	.000	.313
	2006 Population Density	-2.607E-5	.000	.207
	2006 Median Income	7.382E-6	.000	.151
	2006 Percent Unemployed	.015	.010	.150
	2006 Percent Males 15-24	-.023	.023	.329
	2006 Percent Minority	-.001	.002	.515

a. Dependent Variable: Change Property Crime 2005-2006
b. Adjusted R Square: -0.044