PROPERTY CRIME IN THE MONTREAL URBAN COMMUNITY : AN ECONOMIC ANALYSIS

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ABSTRACT

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PROPERTY CRIME IN THE
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This study describes the economic relationships between participants in the property crime market--criminals, police and victims. A three-equation model consisting of the supply of offences, the police production function and the demand for protection is formulated. Employing the thirty-eight districts in the Montréal Urban Community as its sample, the model is estimated by the multiple regression technique of Two-Stage Least Squares for six classifications of property crime, and four measurements of police output.

The model can be used as an aid in measuring the impact of policies intended to reduce the social cost of crime. The direct cost of crime can be reduced by inducing changes in the supply of offences, through either its socioeconomic determinants or the output of the police. Police output can be increased by either increasing inputs, or obtaining a more efficient distribution of resources.

ACKNOWLEDGEMENTS

I would like to take this opportunity to express my appreciation and indebtedness to the numerous people who, knowingly or otherwise, contributed to this study.

Appropriately, first mention should go to Prof. Jon Breslaw who first exposed me to the economics of crime in his undergraduate course and then suggested that I develop my term paper into a thesis. In addition, he served as reader of the thesis, providing helpful commentary.

Friends and fellow students have in many ways contributed to the ideas and work contained in this paper. Gino Tucci, Rasik Hahti and Const. Allen Barbagallo deserve particular thanks. The MUC police department was extremely cooperative and helpful in answering queries and searching for data. I am also indebted to Prof. J. I. Bernstein for his illuminating observation.

Special appreciation is owed to my advisor and mentor, Prof. S. Mehay who was an invaluable source of information and knowledge, and without whose guidance this paper would not have been possible.

Last, but by no means least, I wish to express my gratitude to my wife and family for their encouragement, support and generally putting up with my antics. Additional thanks goes to Rosemarie for her seemingly ceaseless typing.

Of course, any remaining errors are the sole responsibility of the author.

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INTRODUCTION

Contemporary urban economies increasingly are falling victim to what has been euphemistically termed 'fiscal pinch'--a rising demand for services coupled with a diminishing revenue base. Cutbacks and even complete withdrawals of essential services are becoming uncomfortably commonplace.

Economists have responded with a wave of research on topics traditionally considered the exclusive reserve of allied sciences. Into the ranks of the well established and respected fields of the economics of education and health, have sprung the specializations of the economics of locally provided public services such as sanitation, recreation and crime.

Typical of the urban fiscal malaise are the problems associated with the provision of the service, protection from crime. It is this local government service that is the concern of this paper.

This study will attempt to provide an explanation of property crime from an economic perspective. In addition, the effectiveness of the police in their role of providing a deterrent to crime will be examined. The data base used to test the model of crime formulated in this paper is the Montréal Urban Community.

To this end, Part One of this study, a Preamble, places the phenomenon of crime in an economic context and offers insight into the extent and costs of crime as well as the inherent problems of measurement. Part Two presents a critical review of the literature with a view towards laying the theoretical foundation of Part Three in which a model explaining criminal behaviour and depicting society's response

to it is formulated. The main body of this study, Part Four, tests the model and reports the results. Finally, Part Five contains a summary and presents conclusions.

PART ONE

A PREAMBLE

CHAPTER I

CRIME IN AN ECONOMIC CONTEXT

Crime can be defined from an economic perspective as that subset of negative externalities currently defined as illegal. By negative externality it is meant that one or more agents in society impose an unreimbursed cost upon others.[1]

The decision as to which externalities are to be defined as illegal is essentially a function of the intent or irresponsibility of the author of the act, the costs of enforcement, the morals of the time or location and, the biases of the decision makers. An automobile accident causing death is not classified as murder, but the driver may be liable for criminal negligence. The pollution emitted from factory smokestacks may not be regarded as criminal because costs of enforcement (possible closure of the plant) may be considered too high. Gambling and prostitution are two activities whose legal status tends to vary over time and location. Since the people who decide questions of legality are typically from a given economic group, their decisions tend to reflect the the preference orderings of that group. For example, the polluting smoke-stack in the low income neighbourhood may be permitted while noise pollution from motorcycles or speeding cars may be banned in high income areas.

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[1] This definition also apllies to victimless crimes which are believed by decision makers to impose negative externalities upon non-participating agents, for example, other family members or society as a whole.

In Canada, crimes are classified as offences against the Criminal Code, Federal Statutes, Provincial Statutes and Municipal By-Laws. The emphasis of this paper, crimes against property, are a subset of the Criminal Code classification. Property crime is focused upon because of its underlying economic motivation and relative ease in adapting to the tools of economic analysis. A brief discussion of the various categories of the Criminal Code will illustrate these points.

Offences entering the Criminal Code classification can be subdivided into three categories: (1) crimes against the person, (2) crimes against property and, (3) victimless crimes.

Crimes against the person are those acts which inflict violence (or the threat of it) upon members of society. Presumably, the perpetuators of such acts derive utility from causing others pain and suffering while clearly, the victims incur disutility.

Within the framework of Paretian welfare economics, it is not immediately clear if crimes of violence should in fact be illegal. It may be that the utility gains by criminals are greater than the disutilities imposed on victims. In such a case, the Kaldor Criterion might be enacted in which the criminal compensates his victim in order to make him as well off as before, and still maintain a net gain in utility. But as Tullock observed (1, p. 243) the compensation to the victim is in direct contradiction to the objective of the criminal: to cause his victim disutility.

> Since economists . . . have as yet not found a method of comparing gains (in utility) enjoyed by one individual with the losses (in utility) suffered by another individual, there is no way of comparing the utility levels of different individuals into a <u>scalar</u> index that will order social states according to the level of collective welfare. Hence when two states are such that moving from one to the other will make some individuals better off and others worse off, the states are said to be noncomparable (2, pp.305-6).

How then is the economist to explain the illegality of crimes against the person given the state of his art? The task is accomplished by introducing a social welfare function: an ordinal index of society's welfare derived from individual utility levels. The form of the social welfare function

> depends upon the value judgements of its promulgators, since it expresses their views concerning the effects that the utility level of the ith individual has on the welfare of society (3, p.280).

Interpersonal comparison has been brought back into the analysis, fait accompli.

In committing property crime, the criminal's objective is to increase his material well-being. Properly defined by recording agencies (e.g., Uniform Crime Reporting Committee and Statistics Canada) this category includes only crimes in which violence (or threat of it) has not occurred. However, within the context of this paper property crime is defined as all those acts in which the underlying motivation is to increase the criminal's material well-being through a transfer of wealth from victim to criminal. In this respect, property crime can involve violence, but only as a 'by-product' of the act, not as its ultimate objective. For example, in attempting to steal a woman's purse, the thief may inadvertently knock his victim down. In such an event the crime may be classified either as a robbery, an assault or both by the recording agencies.[1] An etiological investigation of such acts should focus upon the desire for economic gain and not the infliction of suffering.

Crimes labelled as the so-called 'victimless crimes' can be given an interesting interpretation from the perspective of Paretian welfare economics. Since the utilities of all participants are increased,

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[1] Robbery is classified as a violent crime by reporting agencies. It is the factor of violence which distinguishes robbery from theft.

Victimless crimes would appear to involve an unambiguous increase in social welfare function. However, there are those who believe that such activities as prostitution and gambling impose negative externalities upon other members of society (e.g., other family members). Presumably, they are of the opinion that such activities contribute to the deterioration of the moral fibre of society.

Suppliers of victimless crimes may be thought of as offering a service or good for which there is a clear demand. Other crimes may be regarded as disservices or bads. Curiously, the Québec Commission of Enquiry has identified victimless crimes along with economic crimes as presenting the most serious threat to society (4, p. 187). Since the issue of victimless crimes has been debated probably since time immemorial, it will not be given further audience here.

Largely due to its unambiguous underlying motivation, property crime has offered the most interest to economists. Indeed, the potentially measurable gains from these crimes are easily adaptable to the tools of economic analysis.

Though the public and media seem to be more concerned with crimes of violence, the problems posed by property crime are by no means insignificant. Statistics Canada has reported (5, p. xiii) that in 1973 property crime represented 46.8% of the total offences in Canada[1] while violent crime only 5.8%. In addition, whereas approximately 45% of all crimes of violence are 'cleared by charge', the same can be said of only 9% of property crimes. Further, only 22% of violent crime is 'not cleared

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[1] In this case total offences include violations of the Criminal Code, Federal Statutes, Provincial Statutes and Municipal By-Laws.

at all' by the police while the same classification applies to 66% of property crime.[1] The extent of property crime and the apparent relative inefficiency of police in solving it underline the need for research into its causes and the probable effects of preventive measures and policies.

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[1] Police classify offences as 'cleared by charge', 'cleared otherwise' or 'not cleared at all'. The first category applies when information has been laid against at least one person. The second category applies when an extenuating circumstance prevents the laying of a charge (e.g., diplomatic immunity, offender is now dead or in another country, etc.).

CHAPTER II

THE EXTENT OF CRIME

The Problems of Measurement

In measuring the extent of crime, one is counting the reported occurrence of criminal incidents. There are many inherent weaknesses in this approach.

First and foremost, the mere counting of offences abstracts from differences in seriousness among incidents. The commonly referred to examples are the published indices of crime.[1] Aggregating criminal events into a single category creates a situation in which theft of an automobile is given equal weight with homicide. The disaggregation of incidents into individual categories by crime types eliminates many of the extreme weighting errors, but they may still exist within each category. For example, the classification of robbery could include such diverse incidents as one schoolboy strongarming another in the schoolyard for his lunch money as well as the more serious offense of bank robbery (6, p. 37).

The Uniform Crime Reporting rules for the scoring of offences also introduce limitations to the interpretations one can make on data intended to measure the extent of crime. Crimes are reported when they become known to the police, which may differ significantly from when they actually occurred. The number of crimes are counted but not the

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[1] In Canada, the 'major crime' index includes homicide, rape, robbery, breaking and entering, theft, and theft of a motor vehicle. While in the U.S., the 'F.B.I. Index' includes willful homicide, forcible rape, aggravated assault, robbery, burglary, larceny of $50 or more and motor vehicle theft.

number of offenders. Violent crimes are measured according to the number of victims, property crimes by the number of distinct or separate operations. Where several offences occur in one incident, the most serious is counted.

Perhaps the most limiting handicap in any attempt to arrive at some quantitative measurement of crime is the fact that not all crime is reported. This problem would not be so serious if the proportion of reported to actual crimes can be assumed constant. However it can be expected that the propensity to report crime varies by the type of crime as well as over different segments of the population. In view of this, a closer estimate of the actual number of crimes might be obtained from victims instead of police. To this end, the National Opinion Research Center of the University of Chicago (NORC) surveyed 10,000 households. The results of their survey are compared with that of the Uniform Crime Reporting system in table 1 for selected crime categories in the United

TABLE 1

COMPARISON OF NORC AND UCR CRIME RATES
(per 100,000 population)

OFFENCE	NORC RATE (1965-1966)	UCR RATE (1965)	FAILURE TO REPORT
ROBBERY	94.0	61.4	34.7 %
BURGLARY	949.1	299.6	68.4 %
LARCENY (over $50)	606.5	267.4	55.9 %
PROPERTY CRIME	1761.8	793.0	55.0 %

SOURCE: The President's Commission on Law Enforcement and Administration of Justice, Task Force Report: Crime and Its Impact--An Assessment (Washington D.C.: Government Printing Office, 1967), p. 17.

States. Assuming the NORC estimates represent the actual level of crime,

the variation in the failure-to-report[1] among the three major property crimes is considerable, ranging from 68.4% for burglary to 34.7% for robbery. Inclusion of all property crimes into a single category produces an average failure-to-report rate of 55.0%, i.e., less than half of all crimes against property are reported.

The propensity to report crime is thought to be influenced by several factors: the differing expectations among different segments of the population regarding police protection; the increasing professionalism of police; insurance requirements; and the classification of crimes. When questioned as to why they failed to report criminal incidents to the police, the majority of households in the NORC survey responded that they believed the police would be ineffective (7, p. 18-21).

Employing U.S. failure-to-report rates as estimates of Canadian rates may introduce an upward bias to estimates of total crime in Canada. As illustrated in table 2, with the single exception of theft, Canadian

TABLE 2

COMPARISON OF CRIME RATES IN CANADA AND U.S., 1973
(per 100,000 population)

OFFENCE	CANADIAN RATE	U.S. RATE
ROBBERY	59.6	182.4
BREAKING AND ENTERING	896.3	1,210.8
THEFT	2,163.0	2,051.2
AUTOMOBILE THEFT	324.0	440.1
TOTAL CRIME INDEX	3,463.5	4,166.4

SOURCE: Statistics Canada, Law Enforcement, Judicial and Correctional Statistics, Service Bulletin vol. 3, no. 11 (Catalogue 85-001), May 1973.

[1] Where failure-to-report = (NORC - UCR)/(NORC).

crime rates are significantly lower than their American counterparts. Partial explanation of lower rates in Canada might be attributable to the hypothesis that Canadian police forces are relatively more effective in crime prevention. Since the majority of households in the NORC survey cited the effectiveness of the police as a prime consideration in their decision whether or not to report crime, the relatively more effective Canadian police would then encourage a higher reporting rate. Thus, the failure-to-report crime in the U.S. might be larger than that in Canada, and estimates of actual crime levels in Canada based upon failure-to-report rates in the U.S., would be biased upward.

The Growth of Crime

Of immense concern to public authorities in recent years has been the growth of crime. Too often, growth rates are reported as annual changes in absolute numbers of crimes, not accounting for increases or shifts in the population. Presented in table 3 are the offence rates for selected property crimes and total Criminal Code violations based upon annual estimates of the Canadian population for a ten year period. The incidence of these crimes has generally doubled in the decade 1965-1974 with the exception of robbery which has almost tripled. With only rare exception the increase has been continuous in each year for each category, with the largest increases occurring in 1968, 1969 and 1974.

Again it must be emphasized that these figures represent not the number of actual crimes, but rather the number that has been reported. Comparing crime data over different time periods suffers from the shortcoming that any changes in the propensity to report on the part of either the public or the police, would produce biased comparisons. In

TABLE 3

CRIME RATES IN CANADA, 1965-1974
(per 1,000 population)

YEAR	ROBBERY	BREAKING AND ENTERING	THEFT	MOTOR VEHICLE THEFT	TOTAL PROPERTY CRIME*	CRIMINAL CODE**
1974	0.76	10.40	24.01	3.71	38.88	64.91
1973	0.60	8.96	21.63	3.24	34.43	58.77
1972	0.54	8.75	21.24	3.23	33.76	54.53
1971	0.52	8.74	21.63	3.05	33.94	54.77
1970	0.55	8.34	20.13	2.95	31.97	52.12
1969	0.48	7.70	17.43	2.83	28.44	47.37
1968	0.40	7.00	16.04	2.50	25.94	43.36
1967	0.35	5.86	14.42	2.20	22.82	38.56
1966	0.29	5.10	13.30	1.98	20.67	35.11
1965	0.28	4.91	12.11	1.94	19.25	32.00

SOURCE: The total number of crimes in 1965-1973 and the crime rates in 1974 were obtained from: Statistics Canada, Crime and Traffic Enforcement Statistics (Catalogue 85-205), 1965-1974. The populations for the years 1965-1973 were obtained from: Statistics Canada, Vital Statistics, vol. 1 "Births" (Catalogue 84-205), 1973.

* Calculated as the sum of robbery, breaking and entering, theft and motor vehicle theft.

** Does not include traffic violations.

addition, the laws themselves, or enforcement policies may have changed. Consider, for example, the changing policy of enforcement against possession of marijuana. The public tolerance towards crime, or as mentioned previously, its attitude towards the police, will have direct effects upon its propensity to report. Likewise, the more efficient are the police, the greater is the proportion of crime that can be expected to be directly reported by them (8, p. 622).

The Distribution of Crime

The incidence of crime is not uniformly distributed throughout the population. Differences in offender as well as victimization rates are discernible across different socioeconomic groups within the population.

The urban environment is believed to account for a larger share of crime than its share of population. The existence of this phenomenon in Canada is verified in table 4 by comparing the shares of total population and crime for ten population groups. Each group represents a range of population size to which cities, municipalities, towns, etc., are assigned according to their individual population. Groups 1, 2 and 3 consistently account for a larger share of crime than their shares of the Canadian population, and all remaining groups generally have disproportionately lower shares of crime. Groups 1, 2 and 3 are composed of the 23 cities in Canada with a population of 100,000 or more. Together they represent 36.59% of the Canadian population, 50.96% of property crimes and 47.67% of total Criminal Code offences.

Why do large cities have a disproportionate share of crime? Do they serve as incubators for criminal types, do they perhaps attract criminals, or do they present an environment in which crime is feasible

TABLE 4

DISTRIBUTION OF TOTAL POPULATION AND CRIME
BY POPULATION GROUPS, 1971

GROUP	POPULATION RANGE (000's)	GROUP SHARE OF TOTAL IN CANADA						
		POPULATION	ROBBERY	BREAKING AND ENTERING	THEFT	MOTOR VEHICLE THEFT	TOTAL PROPERTY CRIME*	CRIMINAL CODE
1 and 2	250 +	26.79 %	60.83 %	35.49 %	37.88 %	43.14 %	38.09 %	35.76 %
3	100-250	9.80	11.58	11.40	12.95	14.34	12.65	11.91
4	50-100	14.26	7.88	9.97	10.51	10.54	10.33	10.02
5	25- 50	7.80	4.74	6.94	8.74	7.99	8.15	7.64
6	10- 25	9.76	4.68	7.75	8.99	7.13	8.44	8.35
7	5- 10	4.23	1.23	2.72	3.30	2.38	3.33	3.19
8	2.5- 5	2.84	0.84	1.77	2.08	1.86	1.96	2.32
9	1.25- 2.5	1.21	0.20	0.66	0.64	0.54	0.63	0.85
RURAL**	. . .	23.31	8.08	23.30	14.91	12.91	16.42	19.96
CANADA	. . .	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %	100.00 %

SOURCE: Calculated from population and crime data obtained from: Statistics Canada, Crime Statistics--Police (Catalogue 85-205), 1971.

*Calculated as the total of robbery, breaking and entering, theft and motor vehicle theft.

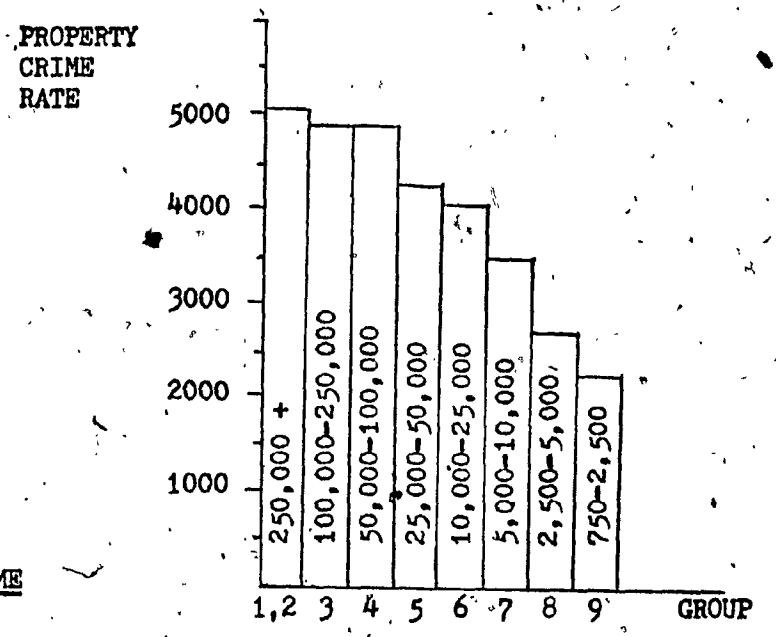
**Calculated as the remainder.

and indeed profitable? Support for the latter explanation is contained in figure 1. Presumably if either of the first two reasons were valid, cities would produce or attract all types of offenders, while the latter explanation would apply only to property crime. As figure 1 (a) depicts, there is a clear and unambiguous increase in the rate of property crime as city size increases. Although figure 1 (b) depicts significantly higher rates of violent crimes in the first two groups, there is no discernible trend according to city size in the remaining seven.

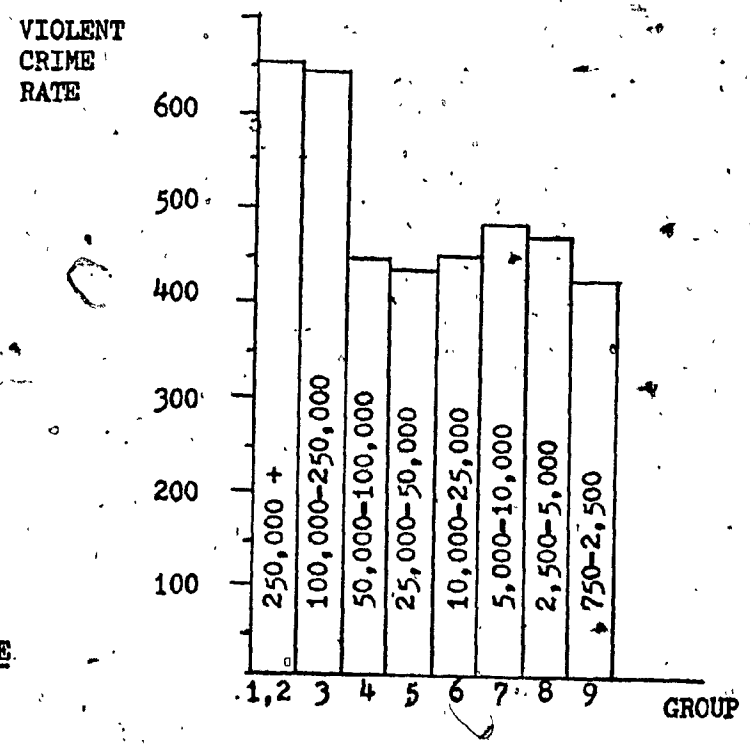
The propensity to commit crime also appears to vary across age groups. The populations of nine age groups and their conviction rates for nine categories of offences are presented in table 5. If the proportion of convictions to total offences is invariant across age groups, then it is possible to make inference about the total criminal population from data describing the subset of convicted criminals. If this proportion is constant, then as one would expect, crime rates first tend to rise with age, reach a peak and then fall off. But what is surprising is the early stage at which the peak is reached. In every category, the 15-19 year olds tend to commit more crimes than any other age group. With the single exception of robbery, the conviction rates for the 15-19 year olds are double the rates of the other groups. The age group with the second highest conviction rates is generally, the 20-24 year olds.

The reliability of employing data on convicted offenders to characterize the total criminal population is critically dependent upon the assumption that the proportion of convictions to actual violations is invariant across age groups. Since the characteristics of the offender are unknown until an arrest or conviction is made, it is necessary to use conviction data in attempting to characterize all offenders. An argument might be made that the young, being relatively

FIGURE 1. PROPERTY AND VIOLENT CRIME RATES BY POPULATION GROUPS, 1974 (per 100,000 population)



A) PROPERTY CRIME



B) VIOLENT CRIME

SOURCE: Statistics Canada, Crime and Traffic Enforcement Statistics (Catalogue 85-205), 1974, p. 3-3.

TABLE 5

CONVICTION RATES BY AGE GROUPS, 1972
(per 1,000 population)

AGE GROUP	GROUP POPULATION (000's)	CONVICTION RATES					
		ROBBERY	BREAKING AND ENTERING	THEFT	MOTOR VEHICLE THEFT*	TOTAL: PROPERTY CRIME**	CRIMINAL CODE
5- 9	2177.3	.00	.03	.02	.00	.05	.06
10-14	2326.9	.02	.69	.68	.04	1.43	1.91
15-19	2162.7	.16	2.50	3.91	.20	6.77	9.71
20-24	1955.0	.12	.62	1.80	-	2.55	4.60
25-29	1660.6	.07	.26	.99	-	1.32	2.64
30-34	1347.1	.04	.13	.75	-	.93	1.90
35-39	1263.7	.03	.11	.61	-	.75	1.52
40-44	1259.2	.02	.05	.62	-	.69	1.30
45-49	1252.3	.01	.04	.55	-	.60	1.00
OTHERS***	6415.7	.02	.19	.69	-	.90	1.52
CANADA	21820.5	.05	.48	1.05	-	1.58	2.57

SOURCE: Total offences by age groups were obtained from: Statistics Canada, Statistics of Criminal and Other Offences (Catalogue 85-201), 1972, and; Statistics Canada, Juvenile Delinquents (Catalogue 85-202), 1972. The populations of the age groups were obtained from: Statistics Canada, Vital Statistics vol. 1 "Births" (Catalogue 84-202), 1973.

*Only available for juveniles.

**Calculated as the sum of robbery, breaking and entering, theft and motor vehicle theft.

***Calculated as the remainder.

inexperienced criminals, might have a higher propensity to be arrested and convicted. The above table would then be understating crime rates as age increased. However, two factors may be at work offsetting this effect. As age increases the criminal (typically a recidivist) becomes better known to the police, increasing his probability of failure. Also, many juveniles are not convicted per se, but informally dealt with by the police or courts; this informal punishment is often considered sufficient. In other words, there is a lower propensity to charge and convict juveniles. The net effect of these factors is, of course, indeterminant.

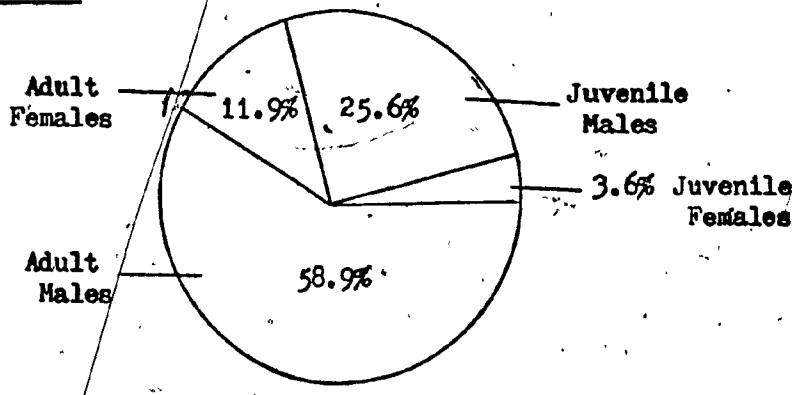
Offender rates can also vary by sex, as males are believed to commit the vast majority of crimes. This phenomenon is vividly illustrated in figure 1 which displays the distribution of charges by sex in 1973. Assuming the ratio of charges to total offences is the same for each sex, then in 1973, males accounted for 84.5% of property crimes, 91.3% of violent crimes, and 86.4% of all Criminal Code offences. These estimates may be biased by the possibility that there is a lower propensity to charge females relative to males.[1]

Not only are there striking differences in offender rates, across different segments of the population, but it has also been shown that there are definite trends of victimization. The President's Commission (7) found that the risk of being victimized by robbery and burglary decline as income rises while that of larceny (over $50) and

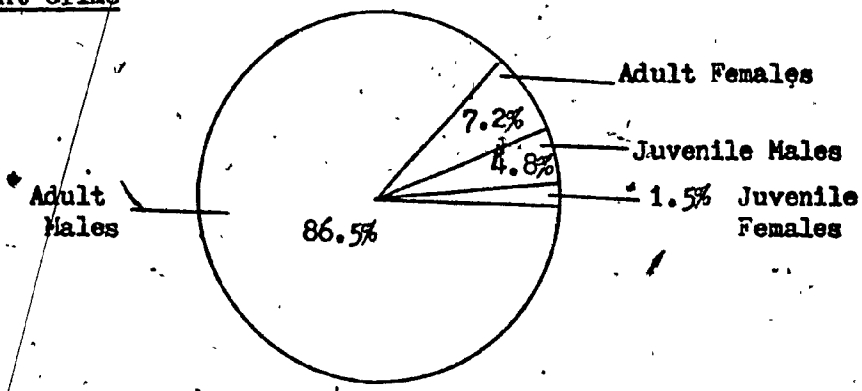
[1] A further discussion of the distribution of crime in Canada employing primarily 1966 and 1969 data can be found in: Beverly Bell-Rowbotham and Craig L. Boydell, "Crime in Canada: A Distributional Analysis" Deviant Behaviour and Societal Reaction, ed. Craig L. Boydell, Carl F. Grindstaff and Paul C. Whitehead (Toronto: Holt, Rinehart and Winston of Canada, Limited, 1972): 93-116.

FIGURE 2. PERSONS CHARGED BY SEX AND AGE CATEGORY, 1973

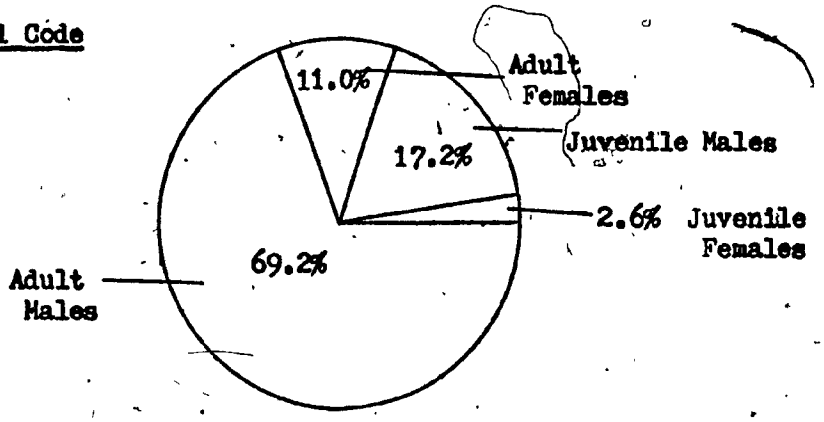
A) Property Crime



B) Violent Crime



C) Criminal Code



SOURCE: Statistics Canada, Crime and Traffic Enforcement Statistics (Catalogue 85-205), 1972-1973, pp. xiii-xiv.

motor vehicle theft tends to rise with income. The incidence of burglary and larceny is significantly higher among male victims, but this may be due to a statistical quirk of assigning crimes against the household to the household head, typically a male. It also appears that the risk of victimization varies by age; this factor is greatest for the 20-29 year old age group.

CHAPTER III

THE COST OF CRIME

Direct Losses

The occurrence of crime imposes direct losses upon its victims. Given that an individual is victimized, he may lose part of his economic wealth and/or suffer pain and mental anguish. The latter two factors are understandably difficult to quantify. The inherent problems of attempting to attach a quantitative value upon life, limb or peace of mind are quite obvious. Economists have used foregone earnings together with medical expenses as a proxy for these losses, with the implicit understanding that it is an understatement of the real losses. Given the state of the art, it is no surprise that economists have avoided empirical analysis of crimes of violence.

Property crime, however, is a different story. In this category of offence, there is a loss of wealth to which a monetary value can be assigned. The assumption that the total loss will be proportional to the pecuniary loss is acceptable.

Data on the loss from property crime in Canada is virtually nonexistent.[1] Robert Evans attempts to estimate the losses from crime in Canada based upon losses in the U.S. as a percentage of GNP (10, pp. 18-22). But this is not an efficient method. Since crime rates are significantly higher in the U.S., their losses as a percentage of GNP should be significantly higher as well. Evans' estimates therefore

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[1] Individual police departments sometimes include the average losses from certain crimes in their annual reports--see for example: Metropolitan Toronto Police, Annual Statistical Report (1972), p.28.

have an upward bias.

An alternative method of estimation is presented in table 6 by using average losses per offence in the U.S. as estimates of their Canadian counterparts. The total Canadian losses are determined by multiplying these average losses with the total number of offences in

TABLE 6

ESTIMATES OF DIRECT LOSSES FROM PROPERTY CRIME IN CANADA, 1974

OFFENCE	AVERAGE U.S. LOSS (1965)	TOTAL OFFENCES IN CANADA (1974)	ESTIMATED GROSS LOSSES IN CANADA	LESS: U.S. RECOVERY RATE (1965)	ESTIMATED NET CANADIAN LOSSES
ROBBERY	$ 254	16,955	$ 4,306,570	11.6 %	$ 3,807,008
BREAKING AND ENTERING	242	233,362	56,473,604	11.6 %	49,922,666
THEFT	84	538,937	45,270,708	11.6 %	40,019,306
MOTOR VEHICLE THEFT	1030	83,309	85,808,270	88.0 %	10,296,992
TOTAL:	-	872,563	-	-	$104,045,972

SOURCE: U.S. data; The President's Commission on Law Enforcement and Administration of Justice, Task Force Report: Crime and Its Impact--An Assessment (Washington D.C.: Government Printing Office, 1967), p. 46. Canadian data; Statistics Canada, Crime and Traffic Enforcement Statistics (Catalogue 85-205), 1974.

Canada. Though admittedly crude and ad hoc this method does serve to highlight the magnitude of property losses suffered by individuals within a few selected categories of property crime . The total net loss from the four categories is estimated at $104,045,972. The reader should bear in mind that this figure is underestimating actual losses. First, it is based upon 1965 values and no adjustment has been made for inflation over the ten year period. Secondly, the number of offences includes only

those reported by the police. As established in chapter II, a significant proportion of property crime goes unreported. Adjustments for unreported crimes based upon the failure-to-report rates in the previous chapter, would double this figure.

The mere existence of crime imposes a cost upon individuals regardless of whether they are personally victimized. Entrepreneurs have the practice of marking-up the prices of all items in order to cover losses from shoplifting. Also, the threat of theft has been shown (9) to impose a form of indirect taxation upon the consumption of stealable goods, resulting in a shift in the consumer's commodity basket--rendering a lower level of utility.

Direct social losses from crime include all those factors which result in a "withdrawal of wealth or productive capacity from the economy as a whole" (7, p. 45). The breaking of a window by a burglar is a reduction in society's wealth, physical injury to individuals reduces society's productive capacity.

Clearly, there is a real social loss from crimes involving violence, but the argument has been made that for property crimes in which no violence or destruction of property occurs, there is no social loss; since all that occurs is a redistribution of wealth. Since interpersonal comparisons are not de rigueur it would appear impossible to judge this argument given the state of the art.

However, Tullock has shown that the mere existence of theft imposes sizable welfare costs even though only a transfer of wealth has taken place: " The (social) cost is that resources are employed in attempting to produce or prevent transfers and not in producing a positive product" (11, p. 230). One might also argue that transfers of wealth involve a social cost because the criminal's gain is less than the

victim's loss. The criminal must invest time and possibly non-labour inputs into the commission of a crime. His 'net' gain is then less than the victim's loss. In addition, the purchasing power of a given 'loot' (assuming it is not cash) is further decreased since the criminal must incur fencing costs. In view of these factors it is difficult to believe that theft, as a transfer of wealth, does not entail a loss in social welfare.

EXPENDITURES ON PROTECTION

The threat of victimization from crime encourages individuals to invest in protection. The form of protection varies from purchasing insurance, burglar alarms and locks, to training in self-defense. Evans (10, p. 21) has estimated total expenditures on these items in 1969 at $235 million. He derived his estimate by applying the U.S. percentage of GNP spent on these goods and services. Since the risk of victimization is higher in the U.S. it is likely that a larger percentage of their GNP is devoted for these items. However, due to a lack of data in the area no better measurement is proposed.

In Canada, all three levels of government allocate a portion of their budget to the Criminal Justice System (CJS), which consists of the police, courts and corrections. The objective of the CJS is to protect persons and property from crime, but its resources are not devoted solely to this effort. For example, the police also render the ancillary community services of searching for missing persons and providing emergency ambulance service. It is impossible to separate from total expenditures those that are spent solely on crime prevention. With this limitation in mind, presented in table 7 are the total expenditures by the federal,

TABLE 7

PUBLIC EXPENDITURES ON THE CRIMINAL JUSTICE SYSTEM
BY LEVEL OF GOVERNMENT, 1963-1972
(in thousands of dollars)

YEAR*	POLICE	COURTS AND CORRECTIONS	TOTAL: CJS	GROSS GENERAL EXPENDITURES (GGE)	CJS AS A PERCENTAGE OF GGE
LOCAL GOVERNMENTS					
1972	$434,070	$16,394	$450,464	$10,262,133	4.39 %
1971	337,096	12,746	349,842	9,439,559	3.71
1970	-	-	310,055	8,032,993	3.86
1969	-	-	260,568	7,267,880	3.86
1968	-	-	225,186	6,564,167	3.43
1967	-	-	219,785	5,858,505	3.75
1966	-	-	173,345	3,943,157	4.40
1965	-	-	159,102	2,799,423	5.68
1964	-	-	143,455	2,739,295	5.24
1963	-	-	132,654	2,553,356	5.20
PROVINCIAL GOVERNMENTS					
1972	$187,588	$261,389	$448,977	$19,063,897	2.36 %
1971	159,039	248,160	496,321	17,310,008	2.87
1970	135,197	214,455	349,652	14,848,598	2.35
1969	116,508	237,897	354,405	12,108,967	2.93
1968	98,700	185,712	284,412	10,331,039	2.75
1967	93,690	142,007	235,697	9,035,884	2.61
1966	78,860	123,280	202,140	7,641,376	2.65
1965	67,733	106,052	173,785	6,343,095	2.74
1964	50,074	95,131	145,205	5,425,406	2.68
1963	41,748	83,685	125,433	4,762,938	2.63
FEDERAL GOVERNMENT					
1972	$198,986	$109,996	$308,982	$18,218,300	1.70 %
1971	167,821	95,742	263,563	15,727,945	1.68
1970	151,783	88,342	240,125	14,085,442	1.70
1969	135,647	79,738	215,385	12,651,980	1.70
1968	118,855	80,606	199,461	11,449,396	1.74
1967	101,275	71,621	171,896	10,030,230	1.71
1966	81,448	68,730	150,178	8,756,179	1.72
1965	76,846	50,319	127,166	8,182,998	1.55
1964	52,892	37,395	90,287	7,728,781	1.17
1963	52,967	33,095	86,062	7,336,824	1.17

SOURCE: Statistics Canada, Local Government Finance (Catalogue 68-204),1963-1972; Statistics Canada, Provincial Government Finance (Catalogue 68-207),1963-1972;Statistics Canada, Federal Government Finance (Catalogue 68-211), 1962-1971.

*In the Federal category, this year refers to the date in which the fiscal year ended.

provincial and local levels of government over a ten year period.[1]

In each category, expenditures have more than tripled over the ten year period (no adjustment has been made for inflation). However, even with these apparently drastic increases, the expenditures on the CJS as a percentage of gross general expenditures at each of the three levels, has increased at only the federal level, and then only slightly with the total increase concentrated in 1965 and 1966. The share of protection services at the provincial level has remained fairly stable over the period, and a slight decline is perceptible at the local level. The increases in expenditures on the CJS has kept pace with increases of other public expenditures, it is therefore difficult to conclude if these increases were a specific response to rising crime rates or a result of across-the-board general increases.

The fact that while over a ten year period, property crime has doubled (see above, table 3, p. 13) even in spite of tripling public expenditures suggests decreasing returns to investment in the fight against crime. Clearly adjustments for inflation would reduce this figure somewhat, but it is expected that the real increase would still be of considerable magnitude.

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[1] Note that the aggregate of expenditures at all three levels is not equal to total national expenditures since intergovernmental transfer payments have not been taken into consideration.

PART TWO

REVIEW OF THE LITERATURE

CHAPTER IV

THE SUPPLY OF OFFENCES

Utility Maximization

Fundamental to economic analysis is the assumption that individuals behave rationally, i.e., they seek to maximize utility. The historical belief that criminals are irrational deviants presented a basic contradiction in the application of economic analysis to criminal behaviour.

Gary Becker, in his milestone contribution (12) provided the theoretical foundation upon which the economics of crime has become a feasible field of endeavor. As postulated in his paper, the criminal is a rational consumer who, given the costs and benefits of the legal and illegal activities, allocates his time between each in such a manner as to maximize his expected utility.

The criminal maximizes expected utility since the maximization process is performed under conditions of risk. Becker introduced one risk factor by explicitly incorporating the subjective proabability of failure at illegitimate activities into his model. Later, in an extension to Becker's model, Kau and Rubin (13) attributed the same explicit role of uncertainty to each individual's probability of not finding employment in the legal labour market.

To reiterate the theoretical framework, each individual allocates his time between legal and illegal activities in consideration of his subjective probabilities of employment in each, and the costs and benefits of participating in each. If the criminal is rational, he will

react to changes in the risk factors as well as to changes in the benefits and costs of each occupation, i.e., his allocation of time to illegitimate activities is not inelastic with respect to these utility parameters. Swimmer (8) has pointed out that individuals will commit all those crimes whose expected utility is greater than the expected utility of using the time in the legal labour market.

The literature since Becker has essentially applied extensions or modifications of the utility maximizing model. The emphasis has been upon empirical investigation. In constructing empirical models, researchers are of course limited by the available data. Understandably, data are not maintained on subjective probabilities of employment in either legal or illegal labour markets. Researchers are forced to rely on proxy variables.

The subjective probability of failure at crime can be represented by either the probability of arrest,[1] the probability of conviction and/or the probability of conviction given arrest. These variables have been represented in the literature by the ratio of arrests to crimes (14-17), the ratio of convictions to crimes (13,16,18,19,20), the ratio of convictions to arrests (16,21), and the police clearance rate which is the percentage of crimes classified as solved (21-25). The choice of which proxy is to be employed is usually determined by the availability of data. The empirical evidence has generally found the response of the criminal community to changes in these risk factors, to be as expected and significant.

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[1] Although it might be argued that a criminal ultimately only fails at crime if he is convicted, the act of arrest can impose constraints on further criminal activity, e.g., he becomes known to the police, or if already known, police files are updated and his movements limited. In this sense, he has failed at crime once arrested.

The proxy used to represent the individual's subjective probability of failure in the legal market has, of course, been the unemployment rate (13,15,17,18,21,23,25,26,27). The results have been mixed, from significantly large, positive and strong elasticities, to insignificant and even unexpected signs. Perhaps unemployment data is not recording the true risk of not finding legal employment, because discouraged workers, not actively seeking employment, are classified not as unemployed, but as out of the labour force. Several studies have recognized this and used the participation rate as proxy for probability of employment (14,18,21,23). It was suggested by Ehrlich (18) that one minus the participation rate may be a proxy measure of illegitimate participation.

Given the empirical evidence, it can be concluded that insofar as the risk factors are concerned, criminals do behave in a manner consistent with economic theory, i.e., rationally. They do seek to maximize expected utilities.

Costs and Benefits

Criminologists, sociologists and social psychologists have looked to the individual's psychic profile as an explanation of criminal behaviour. The economist abstracts from such an approach. He does not deny the possibility of individual proclivity towards crime (as it is often built into his model), rather he emphasizes and focuses upon the implications and effects of varying the costs and benefits of participating in crime. The most immediate cost of criminal behaviour is, given failure, what will be the nature and severity of the ensuing punishment?

The obvious proxy for the severity of punishment is the length

of time served in prison. Surprisingly, the empirical work has produced insignificant and even unanticipated results in measuring the effect of severity of punishment on the supply of crime (13,16,17,20,21), in only two cases did this variable prove to be a significant deterrent to crime (8,18). Avio and Clark (21) suggested that sentence lengths may be simultaneously determined with offence rates. They argued that judges, in perceiving increases in crime, respond with more severe sentences. Unfortunately, none of the other studies treated sentence lengths as endogenously determined.

Economists have recognized that an important element of the cost of participating in illegitimate activities is the opportunity cost. In the case of crime, opportunity cost refers to how the time allocated to crime could have been used in the legal labour market. Differences in the opportunity cost of crime among individuals can be depicted by differences in social or economic conditions. One popular approach towards the reduction of crime is to increase the potential opportunity cost by the amelioration of social justices and equalities of opportunities. Since such policies tend to involve large expenditures and are often in conflict with other priorities, of critical importance is the degree of response from the criminal community to changes in these conditions.

One aspect of opportunity cost is the potential earnings foregone in the legal labour market while participating in crime and/or while incarcerated. Two approaches have been taken in the literature. The first has been to use average or median income levels as a measurement of foregone earnings (8,13-16,18,24,28,29). The second approach has been to employ indicators of the distribution of income (8,13,17-21, 23-25,27,28). Generally the results of the former have been mixed while

that of the latter have been strong, significant and of the expected sign. As discussed in Sjoquist (16), the variable for absolute income levels may be reflecting not only the opportunity cost of crime, but also the potential gain from crime. That is to say, as income increases, so does the concentration of 'stealable' goods. Therefore income can have a positive statistical relationship with crime instead of the expected negative association.

Average incomes conceal how many people are above or below the observed income level while median values tend to hide how far above or below they may be. Variables measuring the distribution of income typically give the percentage of people in the sample below a particular level of income and therefore contain elements of both aspects missing from average and median measurements. An income distribution index may therefore be a closer measurement of opportunity cost within that sample. It can be expected that the shortcomings associated with average and median measurements will increase as the size of the sample observations increase encompassing a more heterogeneous group. As a rule of thumb, one should choose the variable intended to represent opportunity cost according to the level of aggregation in the sample. Typically, the studies employing an index of the distribution of income, use entire cities, metropolitan areas or states as observations.

The individual in deciding whether or not to commit a crime is assumed to consider not only his potential present earnings, but also his potential future earnings, which can be expected to decrease as a result of a criminal record. Present income levels are not considered an efficient measure of expected future earnings because individuals may be at a peak or trough of their earning cycle. Friedman or Ando-Modigliani measurements have not been used because of a lack of time

series data. Several authors have used education levels, particularly those of adults, as a proxy for expected lifetime earnings (14,16,25,27, 30). The underlying assumption is that permanent income is positively related to one's education level. The results are inconclusive, more than likely a problem of collinearity with present income than of the underlying theory. In any case, the recent trend of decreasing monetary returns to education makes the underlying assumption open to additional criticism.

An economic explanation of the phenomenon that juveniles are responsible for a disproportionate share of crime has been suggested by Phillips, Votey and Maxwell (26). They have argued that the young have a relatively lower opportunity cost because their foregone earnings are typically lower, and they bear a higher risk of unemployment in the legal labour market. On the other hand, it might be argued that foregone earnings from a criminal record would be higher for juveniles because they face a longer employment horizon. Most of the empirical studies have included an indicator of the presence of the youth element in the population (8,16-18,21-25,27,30), generally improving the model's explanatory power in the supply of offences.

It has also been established that males tend to commit significantly more crimes than females (see above, chapter II, p. 19). This phenomenon should be particularly disturbing to the economist. Since females generally have lower incomes than males in comparable legal occupations, they should therefore have a lower opportunity cost of crime. They should therefore account for more crimes than males, ceteris paribus. Perhaps the disutility arising from the social stigma of a criminal record may be higher for females. In recent years, the incidence of crimes by females has been rising. This may be explained

by the fact that as more females are entering the labour market (especially into occupations traditionally considered the reserve of males), they are increasingly becoming aware of their lower opportunity cost and are opting for criminal occupations. The literature has incorporated the sexual composition of the population into its analysis in many forms (14,17-19, 21-23, 25). The practice appearing to contribute most to the explanation of crime, is to focus or isolate a socioeconomic feature of a particular sex, such as the male unemployment rate or the female participation rate.

Minority groups are generally associated with higher shares of crime than their shares of the population. The vast majority of U.S. studies examining the supply of offences include some indicator of the population's racial composition. Presumably, what they are attempting to illustrate is not a stronger proclivity towards crime by minority groups,[1] but rather their lower opportunity cost arising from discrimination in the labour market. But discrimination manifests itself in differences in income levels, unemployment rates, education, etc. Therefore, the economist's model of criminal behaviour should rely upon these factors to explain participation in crime by minorities and not racism itself.

Just as a rational consumer reacts to the costs of participating in crime, so should he react to the benefits. Most economic studies of crime have explained only the so-called 'push-effects'--those factors tending to push the individual into crime. Surprisingly, only a few have included the 'pull-effects' in their models (14,16,19,21). By 'pull-effects', one is referring to the attraction of crime presented by a

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[1]The President's Commission found that when other things are held equal, the difference in the participation in crime between whites and blacks is virtually zero.

given victim stock. Data on the average 'pay-off' from property crime is not available, so researchers have resorted to the use of proxies, the most popular of which have been 'residential property values' and 'retail sales'. The underlying assumption of the former is that the value of criminal targets, the contents of a house, is proportional to the value of that building. This is intuitively appealing, since someone who buys an expensive home can be expected to fill it with valuable goods. The variable 'retail sales', is assumed proportional to the value of goods and/or the amount of cash in a retail establishment. Both residential and commercial establishments are potential targets of criminals. However, in defining the victim stock previous studies have included variables to represent either commercial or residential targets, but never both. The true victim stock has therefore been only partially represented in the supply of offences equation.

Properly defined, the pull-effect of a victim stock is composed of two factors: the qualitative appeal of a given victim (measured by the potential gain from the crime), and the availability of the victim stock. The variables retail sales and property value measure the potential value of criminal targets, but give no indication of the presence of such targets. Granted, since the number of houses can be expected to be strongly correlated with the population, the crime rate (determined on a population base) will include the pull-effect presented by the number of houses in the sample. But the same does not apply to the number of retail stores. There is no reason to expect the number of retail stores to be proportional to the population because the size of the store is likely to fluctuate over a considerable range.

The list of factors thought to have an influence on the supply of offences does not end here, it can be extended virtually ad infinitum.

The prime concern of two studies in particular was to identify these factors and attempt to measure their influence on crime. The first by McPheters and Stronge (30) employed Principal Component Analysis.[1] They examined a set of twenty-one factors measuring income and demographic characteristics of central cities and reduced them to their six principal components which were then interpreted as measuring central city decay, central city affluence, minority presence, education, housing quality, and youth presence. The second study by Cho (31) examined twenty-one control policy variables (describing aspects of the Criminal Justice System), seven social service policy variables and nineteen ecological variables thought to influence the supply of crime. Cho employed Stepwise Multiple Regression in which ecological variables are first significantly correlated with crime and then policy variables are introduced to the equation and the impact on crime assessed by the change in the coefficient of determination. These large numbers of variables are essentially variations on the same three themes: probability of failure at crime, the cost of participating in crime and the potential gain from crime. If these effects are accurately specified with a few variables, there is no need for the economist to enter the maze of largely redundant factors having but minor influence upon the supply of offences.

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[1] A discussion of principal component analysis can be found in: Theil, Henri, Principals of Econometrics (John Wiley & Sons Inc., 1971), pp. 46-55.

Aggregation

As the reader has no doubt already observed, the theoretical model of criminal behaviour is based upon microeconomic relationships, while the actual equation being tested, the supply of offences, is a macroeconomic function specified by macro-relationships. This discrepancy is unavoidable because of the lack of data at the microeconomic level.

The variables entering the macro-equation are sums or averages of the micro-variables. For example, the supply of offences is considered a measurement of the sum of each individual's allocation of time to illegal activities. The implicit assumption being that the number of crimes is a monotonically increasing function of the amount of time devoted to it. Variables such as income are averages of individual incomes for a given group or observation. The entire process of aggregation is based upon the belief that in estimation, the macro-parameters are reasonable indicators of the true micro-parameters. It is from these macro-parameters that conclusions will be reached concerning the micro-relations. It is critical then, that the macro-parameters be efficient estimators of the micro-parameters.

Since the majority of the empirical work in this area uses cross-section multiple regression, the choice of the sample is crucial if the macro-parameters are to perform as consistent, efficient and unbiased estimators. Theil discusses the problem of aggregation within a time series context for a changing economy (32, pp. 98-100). The essence of his argument can be applied to cross-sectional studies of crime. The only previous Canadian study, Avio & Clark (21) used provincial observations as the data base. Although the decision was probably taken in consideration of the availability of judicial data, it does impose

severe credibility weaknesses on their results. Provincial observations are an aggregation of rural and urban sectors, which have been shown to display different crime rates (see above, chapter II, p. 14). Figure 3 illustrates the effect of aggregation on estimation. The vertical axis measures the crime rate while the horizontal, the clearance rate, which is assumed to have a negative influence on the crime rate. S_u and S_r

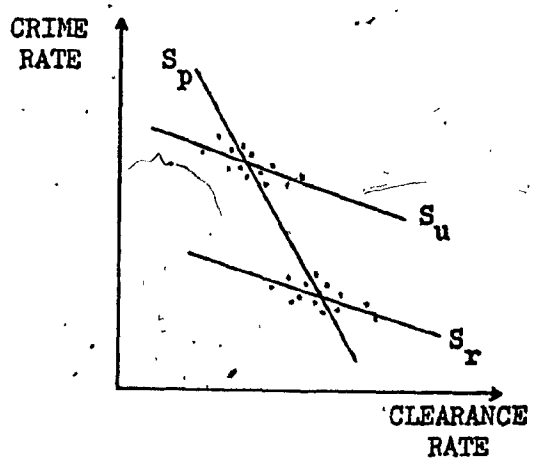

FIGURE 3. EFFECT OF AGGREGATION ON ESTIMATION

represent the supply of offences in the urban and rural sectors respectively. All explanatory factors except the clearance rate are assumed constant. Urban crime rates are, as expected, larger than the rural rates, but note that the rural clearance rates tend to be larger than the urban. This incorporates the belief that rural police departments are more informal and tend to report crime only when making charges that they know will 'stick'. The slopes of each are negative but, as shown, are not steep. In aggregation, the provincial supply of offences, S_p, is also negative and its path is determined by the 'centers of gravity' of each of its subsets. The result is that the provincial macro-parameter, the slope of S_p, is grossly overstating the micro-parameters, the response of criminals to a change in the clearance rate.

An analagous argument can be made against using entire cities or metropolitan areas as sample observations because they include many groups whose participation in crime can be expected to differ. As a rule of thumb, when examining criminal behaviour larger levels of aggregation should be avoided as much as possible within the constraints of available data.

Unfortunately, the vast majority of studies have used intercity samples. On only three occasions have economists used the disaggregated data base of intracity samples. An intracity sample is considered disaggregated because its observations (either police districts or census tracts), contain relatively homogeneous neighbourhoods. One of these three studies, Grieson (28), examined juvenile delinquency in Rochester, New York. Juvenile delinquency, as a subset of crime has several aspects peculiar to itself. Many such crimes (even in the property crime category) may not have the purpose of material gain, but perhaps merely mischievousness. Also, in examining juvenile delinquency, it is not known how many crimes are committed by juveniles until an arrest is made. Therefore the number of juvenile arrests is usually employed as a proxy for the number of juvenile criminals. Because of these theoretical and statistical considerations, the study of juvenile delinquency may be regarded as a separate category of endeavor. Thus, of all the literature on the economics of crime reviewed, there have effectively been only two previous empirical studies at a disaggregated level (25,33).

CHAPTER V

POLICE PRODUCTION FUNCTION

In attempting to quantify the output of the Criminal Justice System (CJS), there seems to be some ambiguity as to precisely what is supposed to be measured. The CJS provides the community with a service, protection from crime. They provide this service by producing crime deterrence, defined by the efficiency of the CJS in identifying, capturing and punishing criminals. Implicit is the assumption that society does not seek to eliminate crime altogether,[1] but to maintain it at some tolerable level. Addressing this objective, Gary Becker posed the optimization question: "How many offences should be permitted and how many offenders should go unpunished?" (12, p. 170).

Carl Shoup (34) demonstrated three criteria upon which the distribution of crime deterrence can be based. The equity criterion requires that crime be deterred until the level of crime is everywhere the same, so that each individual is subject to the same risk of victimization. The efficiency approach distributes deterrence with the objective of minimizing the total number of crimes occurring. Efficient distribution of resources will then occur when the marginal deterrent effect of resources is equal in each district. The optimality criterion takes into consideration the different preferences or tastes of different population segments towards

[1] Total elimination of crime would require a mammoth police force much beyond public tolerance and the capabilities of public funds.

crime. This approach minimizes the total social cost of crime, composed of: (1) the direct losses imposed upon society by crime, and (2) the costs of crime prevention and/or deterrence. It is believed that this latter criterion is in fact the true objective of the CJS. This belief is supported by the fact that the CJS concentrates its efforts against the more serious (costly) crimes such as homicide and armed robbery. Optimality is achieved when the marginal social cost of an additional crime occurring is equal to the marginal social benefit of deterring an additional crime.

The CJS has three instruments with which to attain society's optimization objective--the probability of arrest, the probability of conviction and the severity of punishment. The first can be regarded solely as a function of the police, the second as a joint function of the police and courts, and the third, solely of the courts. The empirical evidence has generally found significant and expected results for the first two activities (13-25) while as previously mentioned (see above, chapter IV, p. 32) the severity of punishment has provided disappointing results.

Because deterrence has been shown to have a strong, direct and unambiguous effect on the supply of offences, the production of it has been given further attention in the literature. Several studies have specified a police production function in the formulation of their models (13,14,15,18,19,21,22,24,25). The variables used to represent deterrence have been the police clearance rate or the ratio of arrests to crimes. Typically, these output measures have been specified as simultaneously determined with the supply of offences.

Inputs into police production functions have included expenditures on police (18,24), manpower inputs (14,19,25), and capital inputs (14). The all-encompassing variable, police expenditures, does little to explain which police activity actually deters crime. Increasing the police budget

in itself does not deter crime, it is how this money is spent that is relevant. Police forces (especially large ones) are increasingly becoming capital intensive with purchases of special equipment and crime fighting technology. The use of total expenditures as an input into the production function, does not indicate if the additional dollars should be spent on men or equipment. Also, it fails to account for differences in costs, such as police wages, across observations.

The definition of manpower inputs is subject to considerable variation in the literature, ranging from total police department employees to total sworn officers, to those policemen directly involved in figthing crime. The first definition includes all civilian employees hired by the police department. Civilian employees may contribute to crime deterrence if they are involved in activities related to intelligence. This category may include electronic data processing personnel and laboratory technicians. However, a large number of civilian employees can be expected to be involved in administrative duties such as secretarial work. A part of the sworn officers can also be expected to be solely involved in administrative functions. The volume of administrative work is largely dependent upon the size of the total police force or city it serves. Administrative activities are not believed to have a direct impact upon the production of crime deterrence. Only those activities directly involved in criminal matters should be considered as inputs.

Mehay (19) has pointed out the two fundamental activities of the police that directly contribute to the production of crime deterrence: patrol and investigation. The patrol factor contributes to crime deterrence in two ways. First patrolling makes the police visible and this sense of presence may deter potential criminals from committing crime because they perceive an increase in the risk of apprehension. Secondly,

the act of patrol, increases the officiency of the police by decreasing the average response time to a call-for-service from any point within their territory. The probability of arrest is increased due to the increased ability of the police to arrive at the scene of a crime before the criminals depart. The activity of investigation increases the probability that the police will discover who committed the crime and the whereabouts of the criminal ex post. As Mehay observed, investigation may be regarded as the long-run arrest activity, and patrol, the short-run.

The production of crime deterrence is also thought to be influenced by environmental, demographic and socioeconomic factors. The ability of the police to apprehend a criminal may be constrained by population density which might aid the criminal in eluding police because of the increase in individual anonymity. On the other hand, Jacobs (35) has argued that high population density contributes to police output, because it increases the likelihood that the criminal will be seen committing the act and therefore reported to the police. Three studies specified density as a determinant of police efficiency (14,21,22), but only two actually estimated the equation. Their results were mixed.

Two studies (13,22) included the size of the population of the observation as a determinant in the production function. The objective being to pick up any scale effects on police output. The results from Carr-Hill and Stern support the belief that there are diseconomies of scale in providing crime deterrence. That is, as the size of the population to be protected increases, the efficiency of the police in producing crime deterrence decreases. This is an interesting finding in view of the recent trend to merge metropolitan and regional police forces in Canada.

Also included in the police production function is a series of socioeconomic variables such as age, income, and education of the population. These factors can influence the efficiency of the police directly or indirectly. For example, people with higher incomes can afford better quality legal advice, and may thus be more effective in avoiding arrest or conviction. Or, since these factors contribute to the crime generating process, they may affect the production function indirectly, by creating a larger workload for the police and thereby decrease the total time that can be devoted to the solving of crimes as opposed to reporting them.

CHAPTER VI

THE DEMAND FOR PROTECTION

The demand for protection can be expected to be determined by the conventional considerations--prices, income and preferences. In this case, protection is a good with characteristics of publicness. The price effects are therefore to be found in the price of publicly supplied police protection relative to the price of an equal amount of protection purchased in the private market. For purposes of analysis, the prices of substitutes are assumed given and fixed. Surprisingly (for economic studies), the price of protection was included in the demand function in only one previous study (14). Although the expected negative relationship (the own-price effect) was found, it was not significantly different from zero. The curious absence of the price effect in the demand functions is a serious shortcoming of previous economic studies.

The budget constraint is introduced to the demand for protection by inclusion of the community's ability to purchase protection. The empirical work has used proxies to represent the variation in this ability across communities, either government revenues or variables measuring the tax base (8,17,21,30,36). The four studies which reported results on the demand for protection found the income effect to be positive (i.e., protection is a normal good), with elasticities ranging from .04 to .31.

The quantity of protection cannot be directly measured, it has therefore been represented in the literature by either total expenditures on law enforcement (8,18,21,30,36), or the amount of manpower inputs

(14,17,22,25,27,28,29,36)[1]--the implicit assumption being that the amount of actual protection is proportional to either of these factors. The demand for police is actually a derived demand--derived from the demand for protection. Police provide not only protection from crime, but also other essential community services such as traffic regulation. Since it is the demand for police that is in fact being estimated, some measurement of the demand derived for non-protection services also should be included. Few of the studies reviewed included an indicator of the possible demand for police services other than protection.

The preferences of individuals as depicted by an indifference mapping between protection and other goods is influenced by several factors. Perhaps the strongest determinant of preferences can be attributed to the risk of victimization. The higher the likelihood of being victimized, the larger a proportion of his budget one is willing to allocate to protection services. Analagously, in the aggregate, the higher the crime rate in a community, the larger will be that community's demand for protection. The risk of victimization has been included in every specification of the demand for protection in the literature. Several, however, used only a subset of the total criminal events such as violent crimes, as a determinant of community preferences (8,14,22,36). The presumption is that the public reacts not only to the number of crimes, but also to the seriousness of crime. The results have been mixed, one study finding a negative relationship (22) another a positive relationship (36).

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[1] These two factors, manpower and expenditures, are highly correlated. For example in 1974, 83% of the Police budget in the Montréal Urban Community was allocated to salaries and fringe benefits. (See Communauté Urbaine de Montréal, Service de Police, Données Statistiques, 1974, p. 20).

Another important determinant of preferences is the potential loss from crime. The higher the potential loss from being victimized, the higher will be the demand for protection. The inclusion of such an influence in the demand for protection has been widespread (8,14,18,22, 27,28,29,36). Proxies such as those employed in the supply of offences to represent potential gain from crime are used to depict the potential loss from crime in the demand for protection. The results tend to support the underlying theory.

In those studies employing intracity samples, the demand for protection abstracts from conventional demand functions. Since there is a single employer and decision maker, the price of the service and the budget constraint are identical for each observation. The entire community's demand in interpreted by the local government and a part of its budget is then allocated to the police department. The police in turn distribute their service, protection, across districts within the city. The equation conventionally used to describe the demand for police becomes, in effect, a 'deployment function' within a single community.

CHAPTER VII

PREVIOUS ECONOMIC MODELS OF CRIME

In the formulation of their models, previous economic studies have examined the supply of offences equation both singly and simultaneously with either the crime deterrence production function (13,15,19,24,27), the demand for protection (8,17,28,29,30,36), or both (14,18,21,22,25).

Studies examining the supply of offences alone have been interested solely in the behaviour of offenders. Without exception, they employ the exogenous variables of police inputs or probability of arrest and/or conviction to represent crime deterrence. Generally, they found the activities of the CJS to provide a significant deterrence to criminals. However, police inputs and the output of arrests and/or convictions is believed to be simultaneously determined with the supply of offences. The single equation models are therefore inappropriate specifications of the problem.

Those studies employing two-equation models consisting of the supply of offences and demand for protection functions, have specified police inputs as a determinant of the supply of offences. This may be a misspecification of the problem. The police only influence the crime rate indirectly, not by their mere existence, but rather by their output, the production of deterrence. The more efficiently the police solve crimes and apprehend criminals, the greater will be their deterrent effect upon crime. An increase in the police presence will only deter crime to the extent that the criminal's subjective assessment of the probability of arrest has increased. If additional police do not increase the actual

police output (the probability of arrest), in the long run criminals will adjust their evaluation of risk downward and the supply of offences will increase accordingly. Since manpower inputs are only one of several factors expected to influence police output, the inclusion in the model of the production function would appear beneficial. The suspicion that these models misspecify the problem is reinforced by the unpredicted positive influence of police inputs often found in the supply of offences (17,28,29,36), and sometimes attributed to the so-called reporting phenomenon (36).

The models employing the two-equation system of the supply of offences and the police production function are believed to be correctly specifying the influence of police on crime: i.e., through the output of crime deterrence. However, in the specification of the police production function, the majority include police inputs as a predetermined explanatory variable. It is believed that police inputs are simultaneously determined by the supply of offences. That is to say, the demand for protection is a function of the risk of victimization. These two-equation models are therefore also considered to be incomplete specifications of the problem.

The complete model of crime and households' reaction to it is best depicted by a three-equation system consisting of the supply of offences, the production of crime deterrence and the demand for protection. The equilibrium amounts of crime, police inputs and police protection are determined by the system. There have been five studies employing basically this approach (14,18,21,22,25), but theoretical and statistical shortcomings can be found in each.

As illustrated in table 8, in four of the five studies the police production function is specified to include the offence rate as a determinant of the clearance rate or probability of arrest (18,21,22,25). The

TABLE 8

SPECIFICATION OF CJS VARIABLES*
IN THREE-EQUATION MODELS
(X indicates usage)

STUDY	DEPENDENT VARIABLE	CR	CL	P(A)	P(C)	S	COPS	E
AVIO AND CLARK (21)	CR		X		X	X		
	CL	X						X
	E	X	X					
CARR-HILL AND STERN (22)	CR		X				X	
	CL	X					X	
	COPS	X	X					
CHAPMAN (14)	CR		X					
	P(A)						X	
	E	X						
ERHLICH (18)	CR			X				
	P(A)	X						X
	E	X						
THALER (25)	CR		X				X	
	CL	X					X	
	COPS	X						

*The variables are: CR = crime rate; CL = clearance rate; P(A) = probability of arrest; P(C) = probability of conviction; S = severity of punishment; COPS = police inputs; E = police expenditures

reason usually given for the inclusion of this variable is to allow for either increasing or decreasing returns to scale (25, p. 9). In other words, the marginal productivity of police resources is assumed to change as the scale of operation increases. This appears to be a misspecification of this relationship. The offence rate does not influence the clearance rate directly, but only indirectly through its influence upon the demand for police. As the offence rate increases, the demand for police increases. If police productivity varies as the offence rate increases, then a non-linear relationship between police and their output would be the proper specification.

Another fault common to two of the studies is the use of the

clearance rate as a determinant of the demand for police (21,22). The argument is that as the clearance rate rises, society's perception of the severity of the crime will decrease (21, p. 18). But the output of the police should only influence society's perception of the severity of the crime problem by its effect upon the supply of offences. The clearance rate plays a determining role upon the supply of offences which in turn influences households' demand for protection.

In their supply of offence equations Carr-Hill and Stern and Thaler each included both the clearance rate and police inputs as explanatory variables. Typically, police inputs will influence the supply of offences only through the production of deterrence. However, as already pointed out, in the short run additional police may directly influence the supply of offences even if they do not contribute to the production of deterrence. This will occur when the criminal community perceives an increase in the police presence and therefore raises their subjective evaluation of the probability of arrest. If this effect is to be included in the explanation of crime then it should be represented not by total police, but only by those officers visible to the criminal community. Unfortunately, both Carr-Hill and Stern, who employ total police personnel, and Thaler, who did employ visible patrolmen, found the relationship to be positive, contrary to expectations.

All five studies neglected to include in their demand for police functions any representation of the demand derived for non-crime related services such as traffic regulation or emergency ambulance services.

The relationships described in the preceding discussion were estimated by conventional multiple regression techniques. The majority of the papers used either Ordinary Least Squares, Two Stage Least Squares methods of estimation or both. Linear and non-linear specifications have

been employed with the latter generally improving the explanatory power of the models.

Those factors which were treated as endogenously determined in the supply of offences included variables intended to represent the probability of arrest and the severity of punishment. In the former case it was argued that the probability of arrest is influenced by the level of criminal activity, or in other words, there are scale effects present. The severity of punishment was assumed to be influenced by the crime rate by judges who respond to increases in the crime rate with stiffer sentences.

The production function for crime deterrence has included the endogenously determined explanatory variables of police inputs and, as already mentioned, the crime rate. Justification for treating inputs endogenously is that since the objective function of households is to minimize social cost, as the efficiency of police increases, fewer police will be demanded. Estimates of the equation depicting the demand for protection specified the crime rate and the productivity of police as endogenous variables, simultaneously determined.

PART THREE

CRIME, DETERRENCE AND POLICE : THEIR INTERACTION

CHAPTER VIII

THE THEORETICAL FRAMEWORK

This study will extend the tradition begun by Gary Becker in treating the criminal as a rational individual, allocating his time between legal and illegal activities with the objective of maximizing expected utility under conditions of uncertainty. The behaviour of the individual is best illustrated by a Von Neumann-Morgernstern expected utility index. The form used in this instance is a modification of that employed by Kau and Rubin (13) which in turn, is an extension of the model first postulated by Becker (12). The i^{th} individual is assumed to maximize expected utility based upon the incomes of four possible states of the world:[1]

$$(1) \quad E(U) = (1-p)(1-u)\,U\left[W_L t_L + W_c t_c\right] + p(1-u)\,U\left[W_L t_L + kW_c t_c - L\right] + (1-p)(u)\,U\left[W_c t_c\right] + puU\left[kW_c t_c - L\right]$$

subject to:

$$(2) \quad t \geq t_L + t_c$$

where:

p = subjective probability of failure at crime; $0 \leq p \leq 1$

u = subjective probability of unemployment in the legal labour market; $0 \leq u \leq 1$

W_L, W_c = the wage in the legal and criminal markets, respectively

[1] For purposes of simplification the subscript 'i', and utility derived from initial asset holdings are omitted.

t_L, t_c = the time allocated to the legal and criminal markets, respectively

t = the total amount of time available for employment

k = the proportion of criminal income 'not' recovered by police given failure at crime; $0 \leqslant k \leqslant 1$

L = the cost of failure at crime.

The allocation of time between the legal and illegal labour markets will be in equilibrium when the expected net marginal incomes are equal in each. A sufficient condition for the equilibrium of equation (1) is that criminals be risk averse.[1]

Each individual is assumed to consider two risk factors, the subjective probabilities of failure in both legal and criminal labour markets. Increases in either of these factors will reduce the expected income from that activity. Increases in one risk factor may be completely offset by decreases in the other, leaving total expected income unchanged. But note that compensating changes in the risk factors are not a necessary result of equal or proportionate changes.

The wage rate of each activity represents monetary income. Psychic income from legal and illegal activites can also be expected to influence the allocation of time between the two markets. For example, someone with a strong sense of 'morality' may derive psychic income from not engaging in crime, and therefore allocate more time to employment than the model predicts. Given the difficulties of quantifying psychic income, it is normally not explicitly incorporated into the economist's model of criminal behaviour. However, the empirical specification often introduces implicit reference to psychic income by anticipating variations in criminal

[1] The derivation of this condition is given in appenddix A.

participation across different segments of the population. For example, inclusion of a variable representing youth in the supply of offences may explain psychic income from adolescent mischieviousness in addition to the expected lower opportunity cost of the young (see above, p. 34). In any case, it is the influence of pecuniary incentives that the economist desires to focus upon in examining criminal behaviour. As Becker has demonstrated, the individual will allocate more time to illegal activities by (1) positive changes in the illegal wage and probability of legal unemployment, and (2) negative changes in the legal wage, and the cost and probability of arrest.

The total cost of crime, L, includes: legal fees, time and income foregone during defence, pre-trial and post-trial incarceration, mental anguish, severity of punishment if convicted and subsequent reduction in potential future earnings resulting from a criminal record. The structure of the utility index presented above, incorporates the fact that legal unemployment occurs ex ante to legal income, i.e., given unemployment, legal income is zero (a more accurate specification would incorporate unemployment insurance benefits with a time lag to indicate when they are exhausted). On the other hand, failure at crime can occur prior to, during or after the actual event.

Previous studies have employed expected utility indices specifing that criminal income will be retained regardless of arrest and conviction (12,13,16). However, if failure at illegal activities occurs ex post to the crime, some part of the 'loot' could be recovered by the police. These previous models have therefore overstated actual criminal income. This paper incorporates the parameter k, to represent the portion of criminal income consumed or retained by the criminal regardless of arrest and/or

conviction. If failure occurs before or during the crime, or if all the loot is recovered, then k=0; likewise if the criminal consumes all his income prior to arrest or conviction, or manages to keep it from the police, then k=1. The size of k may be a function of the time lapse between the occurrence of a crime and subsequent arrest, therefore the efficiency of the police in shortening this time lapse will have an influential effect upon net illegal income by decreasing the ability of the criminal to enjoy the proceeds of his endeavors.

Due to limited data availability it is necessary to carry out empirical tests at an aggregate level. To accomplish this task, the economist employs the relationships referred to as the 'supply of offences'. The validity of examining this aggregate relationship in place of the theoretical microeconomic relationships, is based upon several assumptions. First, the supply of offences is assumed to be a monotonically increasing function of the total amount of time allocated to the illicit activities. Secondly, it is assumed that the parameters describing the behaviour of the aggregate observations are representative of those for each individual within that group.

To depict the supply of offences and related aggregation phenomenon, the general functional form is employed:

$$(3) \qquad CR_j = f_j (P_j, L_j, G_j) \qquad j = 1, \ldots, n$$

where:

CR_j = the crime rate for crime type j

P_j = the probability of failure at crime type j

L_j = the cost of participating in crime type j

G_j = the gain from crime type j

The following behavioural relationships are expected:

$$\frac{\partial CR_j}{\partial P_j} < 0 , \quad \frac{\partial CR_j}{\partial L_j} < 0 , \quad \frac{\partial CR_j}{\partial G_j} > 0 .$$

The objective of the Criminal Justice System (CJS) is assumed to be the minimization of the social cost of crime. This goal is achieved by the optimal production and distribution of crime deterrence services through the activity of arrest and conviction of criminals. The output can be measured by the ratio of crimes solved (the probability of failure at crime). The production function of the CJS can be described by the following equation:

$$(4) \quad P_j = g_j (I,E) \qquad j = 1, \ldots, n$$

where:

I = a vector of inputs into the CJS

E = a vector of environmental and demographic factors believed to affect the output of the CJS.

It is anticipated that $\partial P_j / \partial I >$ and that the sign of $\partial P_j / \partial E$ will of course depend upon whether the factor under consideration is thought to help or hinder the enforcement of law.

The CJS is composed of the police, the courts and the correctional system. The police and the courts are direct contributors to the output of crime deterrence via the probability of failure at crime; corrections are not a contributor to crime deterrence per se, but rather to the cost of failure at crime. The validity of this supposition is based upon the belief that the correctional system influences mainly the severity of punishment.[1] Expenditures on corrections will have two effects. First,

[1] Although corrections may have no influence upon the length of sentence, the quality of the facilities and the daily rules and procedures of prison life clearly have a direct impact upon the severity of punishment.

better rehabilitation programs will enable ex-convicts to qualify for better employment upon release--recidivism rates will decrease. However, better prison facilities will also make an inmate's sentence more tolerable and thus decrease the severity of punishment. These two effects may cancel each other, leaving no net change in the output of crime deterrence. For these reasons the inputs of police and the courts and not of corrections are focused upon in this paper. Indeed, the role of corrections might be considered as solely the administering of the decisions reached by the courts.

The demand for inputs into the CJS by households is derived from their demand for protection. Each household's demand is determined by its expected cost of victimization which in turn is determined by its risk of victimization and the potential loss from victimization. Each household will invest in self-protection such as door-locks, burglar alarms, etc., in order to decrease the risk of victimization. The community will also demand the public good, police protection, which is also determined by the expected cost of victimization. Assuming the objective of households to be minimization of the social cost of crime, then publicly supplied protection will be demanded until the marginal social cost of crime is equal to the marginal social benefit of reduction in crime. The demand function can be represented as follows:

$$(5) \quad I = h(CR_j, X, Y) \qquad j = 1, \ldots, n$$

where the crime rate, CR_j, represents the community's risk of victimization. It is anticipated that $\partial I / \partial CR_j > 0$. The vector X contains variables believed to explain differences in the demand for protection across communities (for example, preferences). The budget constraint is represented by Y, the ability of communities to purchase protection.

The $(1 + 2n)$ variables CR_j, P_j and I are endogenous to the system of the $(1 + 2n)$ equations to be estimated (3), (4) and (5). They are simultaneously determined because an autonomous change in any of these endogenous factors will induce adjustments in the others. The policy control variable is I, that is to say, households will adjust their demand for I in order to reach equilibrium where the social cost of crime is minimized.

PART FOUR

THE EMPIRICAL ANALYSIS

CHAPTER IX

THE DATA BASE

The Intracity Study

The three equations presented in this study-- the supply of offences, the police production function and the demand for protection-- will be estimated with a sample of police districts within the Montréal Urban Community (MUC).

The MUC was established January 1,1970 as a form of regional government, amalgamating the provision of services by the twenty-nine municipalities on the island of Montréal and Ile Bizard. The intention of such metropolitan amalgamations are typically (1) to capture any economies of scale, (2) to equalize the quality of services and, (3) to attain an equitable distribution of the costs.

The MUC Police Department was legally integrated January 1, 1972. It presently consists of thirty-nine police districts--sixteen of which are in the city of Montréal with the remaining twenty-three representing the twenty-eight suburbs. This study will employ thirty-eight of these districts as sample observations.[1]

The MUC was chosen as the data base for several reasons. First, crime in Canada has been examined by economists on only one other occasion,[2] Avio & Clark (21). They employed provincial observations, increasing the likelihood and severity of aggregation problems and producing spurious

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[1] District 8 is omitted since it consists entirely of a non-residential recreation area (Terre des Hommes) thus constituting a special form of market for crime.

[2] Another by Stephen Mehay of Concordia University is presently underway.

results (see chapter IV above, pp. 38-40 for detailed discussion). In addition, due to data unavailability, their sample does not include the provinces of Quebec and Alberta.

Property crime in Montréal appears to be more serious a problem relative to violent crime, whereas in Toronto the situation is reversed. As table 9 illustrates, violent crime rates in Toronto tend to be higher than those in Montréal--in the assault category, the Toronto rate is more

TABLE 9

COMPARISON OF CRIME RATES IN MONTREAL AND TORONTO
(per 100,000 population)

OFFENCE	TORONTO	MONTREAL
HOMOCIDE:	2	3
RAPE:	10	7
ASSAULT:	22	10
VIOLENT CRIME	34	20
ROBBERY:	76	175
BREAKING AND ENTERING:	585	1352
THEFT:	2447	1995
MOTOR VEHICLE THEFT:	327	430
PROPERTY CRIME:	3435	3952

SOURCE: Communauté Urbaine de Montréal, Conseil de Sécurité, Sommaire Statistique, 1974.

than double that of Montréal. On the other hand, the rates for robbery and breaking and entering in Montréal are more than double those of Toronto. Only for the less serious property offence of theft is the Toronto rate greater than Montréal's. Montréal appears to constitute an attractive market for property crime relative to Toronto.

A study employing intracity data has several distinct advantages and disadvantages over a study using intercity or interprovincial data. The intracity study refers to a single police department, therefore the data are likely to be more reliable because the single reporting agency

interprets the rules established by the Uniform Crime Reporting System in a consistent manner. This also implies that there is a single policy regarding the enforcement of laws. For example, laws against jay-walking and possession of marijuana may be strictly enforced in some cities while not in others so that the data may yield misleading interpretations as to the distribution of these crimes. Within a single city, there will be a tendency for uniform enforcement. From the policy perspective, examining the problem within the domain of a single authority is more pragmatic in that any conclusions and recommendations have a greater likelihood of being implemented since the conflict of interests and priorities is greatly reduced.

A major weakness of the intracity study is the difficulty and sometimes impossibility of obtaining data--the lower the level of aggregation, the less information seems to be published. In this case, the most serious problem is the unavailability of data on two of the three variables that represent important functions of the CJS--conviction rates and the severity of punishment. However, since the intent of this study is to focus not upon the CJS per se, but rather upon the impact of police, the loss though damaging, is not completely destructive. There is a relative abundance of data on police activities at the disaggregated level of the intracity sample.

Another problem associated with an intracity study is the existence of spillovers. In an intercity sample, it is not unreasonable to assume that the criminal resides in the city in which the crime occurred. On the other hand, it would not be as acceptable to assume that criminals commit crimes in their own neighbourhoods. The a priori expectation is that criminals would tend to commit more serious crimes further from their residence if only for the reason of decreasing the probability of

apprehension through recognition. Thus the problem of spillovers between neighbourhoods should be more prevalent as the seriousness of the offence increases. Since for any given crime it is impossible to know with certainty the residence of the criminal, it is necessary to rely upon data associated with the district in which the crime occurred. As the presence of spillovers increases, those variables intended to describe the characteristics of the criminal may in fact be only reporting those of the victim.

Furthermore, the model specifies the supply of offences by a given district. Although the model may in fact be accurately measuring the number of crimes committed by the population in that district, the data may be overreporting the offence rate due to crime spilling-in from other districts (or underreporting due to spill-outs). For example, the model may efficiently estimate the number of offences delivered by a low income neighbourhood, but the data might not accurately report this amount because some of their crimes could conceivably be committed in high income areas where the potential criminal income is larger. A variable attempting to account for the presence of spillovers is incorporated into the model.

The Variables

Crime and police data were obtained from MUC police publications. All of the crime and most of the police data pertains to 1972, although several police statistics were only available for 1973. All of the socioeconomic data was taken from the 1971 census with one exception, retail sales, which was only available for 1966. Socioeconomic data is published at the municipal level which coincides with the 23 suburban observations in this sample. However, this same data is not published

at the police district level (for the 15 observations in the City of Montréal), but only by census tracts. The 291 census tracts in the City of Montréal were assigned to their respective police districts by visual identification. The required variables at the district level were then obtained by aggregating the census tract data. The source and, when applicable, calculation of variables employed in this study are contained in appendix B.

The behavioural relationships of the following property crimes will be examined: robbery, ROB; breaking and entering, BNE; grand theft ($>\$50$), GRAND; and petty theft ($\leqslant\$50$), PETTY. Criminals may specialize in a particular type of crime or be mobile between criminal occupations: i.e., crime types may be complements or substitutes. In order to capture the possibility of complementarity, two additional crime classifications are specified as aggregations of the above categories; specifically, total property crime (the sum of robberies, breaking and enterings, grand thefts and petty thefts), PROP, and total theft (the sum of grand and petty thefts), THEFT.

The police clearance rate is employed as a proxy for the probability of failure at crime. Unfortunately, as already mentioned, judicial data on convictions and severity of punishment are not available at the disaggregated level of police districts. The clearance rates for robbery, breaking and entering, and total thefts are available, and the clearance rate for property crime is calculated from these. Clearances for grand and petty thefts are not available, so the clearance rate for total thefts is used in their place. Also, it should be noted, that the clearance rates of robbery and breaking and entering are different from that used for thefts. In the first two crime categories the classification 'cleared by arrest' is employed, while for thefts, the only available

data was the total clearance rate (that is, cleared by arrest or otherwise). At the expense of consistency, clearances by arrest only are used when available for two reasons. First, it is believed that clearances by arrest are, relative to total clearances, a more accurate proxy for the criminal's subjective perception of the probability of failure at crime. Clearances other than by arrest include situations in which the police cannot lay a charge against the suspect due to extenuating circumstances. The criminal therefore does not incur a cost from detection and is unlikely to be deterred by it. This will be especially true for the recidivist who is already known to the police. Secondly, the classification 'cleared otherwise' is believed to be more subject to manipulation by police, whereas they cannot alter the 'cleared by arrest' classification without actually producing an arrest and laying a charge.

The risk factor in the legal labour market is represented by the male unemployment rate. The male unemployment rate is used because as shown in chapter II (pp. 19-20) males account for a disproportionate share of arrests and presumably crime. Also, to the extent that female employment is a secondary source of income for the household--often intended for savings--the pressure or necessity of unemployed females to participate in criminal activities may not be as great as that for unemployed males, typically the heads of households.

The opportunity cost of crime is included in the supply of offences equation by the proxy, average household income which represents foregone earnings. A problem is anticipated that this variable may represent not only opportunity cost, but also the potential gain from crime. This latter influence will most often be present when spillovers among neighbourhoods are prevalent; the income variable will then be

reporting the tendency for crimes to be committed in high income districts because of a larger potential payoff from any given crime.

The criminal wage would be represented best by average monetary losses from each type of crime in the past. Unfortunately such data is not available, in its place a proxy variable for the potential 'payoff' is employed. Since criminal targets include both commercial and residential victims, the proxy should incorporate the influence of both on the criminal wage. The following proxy is employed:

$$GAIN_y = VALUE_y + SALES_y \qquad y = 1,\ldots,m$$

where:

$GAIN_y$ = potential gain frim crime in district y

$VALUE_y$ = median property value for single detached dwellings in district y

$SALES_y$ = average sales per retail store in district y

The targets of criminals, cash and 'moveable goods', will be proportional to the average sales in retail stores. In the case of residential victims, the value of criminal targets is represented by the contents of a house and is assumed to be directly proportional to the value of that house. Thus this proxy attempts to represent a wider spectrum of victims in the formulation of the criminal wage than previous studies (see pp. 35-36 for discussion) which have at times been hard pressed for a reasonable proxy--Avio & Clark (21) used the 'number of households with record-playing equipment.' It is assumed that the criminal wage from each of the property crimes examined (robbery, breaking and entering and theft) will be proportional to this variable.

As already pointed out, the intracity sample is expected to contain spillovers of crime among the observations of police districts. Previous studies employing intracity samples suffer from the weakness of not attempting to deal with this obvious problem in estimating the supply of offences. Thaler (25) discussed the problem in reference to a variable he used to represent the criminal element of each observation. However, he declined from making any explicit predictions regarding spillovers. A proxy variable is incorporated in the present supply of offences function to account for such spillovers. It is postulated that, if criminals residing in district 'i' perceive a lower probability of failure in district 'j', they will tend to commit their crimes in district 'j'. The tendency of crime to spillover will decline as the distance between 'i' and 'j' increases for two reasons: (1) as the distance increases, criminals are unlikely to have reliable information on district 'j' and, (2) the costs of transportation increases thus reducing the net expected gain. The size of the spillover can also be expected to depend upon the population of each district. Based upon these two considerations, the share of the population of any district in a 'contiguous community' is used as a weight to measure the size of potential spillover. A 'contiguous community' is defined for each district 'i' as the total population of district 'i' and that of all r districts immediately adjacent to 'i'. Adjacent districts were identified visually (a list of each district's contiguous community is contained in appendix B). The following variable is specified to account for lower crime rates in district 'i' due to spillovers into its contiguous community of adjacent districts:

$$SPIL_i = \sum_{j=1}^{r} (S_i CL_i - S_j CL_j)$$

$$= r(S_i\ CL_i) - \sum_{j=1}^{r} S_j\ CL_j$$

and, $SPIL_i \gtrless 0$

where:

$SPIL_i$ = the net spillover of crime in district 'i'

r = the number of districts immediately adjacent to district 'i'

CL_i, CL_j = the clearance rate for property crime in districts 'i' and 'j' respectively

S_i, S_j = the share of the total population of the contiguous community in districts 'i' and 'j' respectively[1]

If $SPIL_i > 0$ (< 0) there is a net spill-out (spill-in) of crime from (into) district 'i'. If $SPIL_i = 0$, there is no net change in the crime rate of district 'i' due to spillovers.

Anticipating the relatively high crime rates displayed by youthful males (see above, chapter II pp. 19-20) an additional variable is introduced to account for this group's relatively low opportunity cost of crime or its relatively high 'taste' for crime; the variable used is the percentage of the population being males 15-24 years old.

Unfortunately, data on the police recovery rate or their efficiency in shortening the time lapse between the occurrence of the crime and subsequent arrest, were not available. The influence of the parameter k is therefore omitted from the empirical specification.

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[1] The share for the k^{th} district (where k is district i or j) was calculated as follows: $S_k = \dfrac{POP_k}{POP_i + \sum_{j=1}^{r} POP_j}$

The following then, is the structural form of the supply of offences equation to be estimated:

$$(6) \quad CR_{gy} = A_{1y}\, CL_{gy}^{B_1}\, BOYS_y^{B_2}\, UNE_y^{B_3}\, INC_y^{B_4}\, GAIN_y^{B_5}\, SPIL_y^{B_6}\, \exp.\, u_{1y}$$

$$g = 1,\ldots,m$$
$$y = 1,\ldots,q$$

where:

CR_{gy} = the rate (per 1000 population) of crime type 'g' in district 'y'

CL_{gy} = the clearance rate for crime type 'g' in district 'y'

$BOYS_y$ = ratio of males 15-24 years old to the total population in district 'y'

UNE_y = the male unemployment rate in district 'y'

INC_y = average household income in district 'y'

$GAIN_y$ = the criminal wage in district 'y'

$SPIL_y$ = the net spillover in district 'y'

and, A_{1y} = the intercept

u_{1y} = the disturbance term

The expected behavioural relationships are as follows:

$$B_1 = \frac{\partial\, CR_g}{\partial\, CL_g} < 0\,, \qquad B_2 = \frac{\partial\, CR_g}{\partial\, BOYS} > 0\,, \qquad B_3 = \frac{\partial\, CR_g}{\partial\, UNE} > 0\,,$$

$$B_4 = \frac{\partial\, CR_g}{\partial\, INC} < 0\,, \qquad B_5 = \frac{\partial\, CR_g}{\partial\, GAIN} > 0\,, \qquad B_6 = \frac{\partial\, CR_g}{\partial\, SPIL} \gtrless 0\,.$$

The police output of crime deterrence is measured by their efficiency in solving crimes, the clearance rate. The conventional method of defining inputs into the police production function is to normalize observations on a population base, for example, police per

capita. It is believed that a more accurate comparison of the effect of police on crime between observations will be achieved by normalizing inputs according to the workload, i.e., police per crime.[1] This approach then enables both variables to be based upon identical denominators,[2] eliminating all variations but those in the relationship between police and their output. Estimates of the supply of offences and production of crime deterrence functions employing the conventional definition of police inputs (police per capita) are reported in appendix C.

Most of the capital investment on such items as laboratory equipment in the police production function is intended to serve the entire department. It is impossible to identify and isolate total non-manpower expenditures allocated to each district. Capital expenditures which can be identified at the local level are primarily investments in transportation; i.e., automobiles and motorcycles. It is assumed that capital expenditures at the local level of the police district are proportional to the number of automobiles, and therefore, the proxy, police cars per policeman, is employed to represent capital investment in crime fighting technology at the district level.

The efficiency of the police is often influenced by environmental conditions. One such element receiving attention in the literature has

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[1] Appreciation for this point is owed to Prof. J.I. Bernstein, who of course is not responsible for any remaining errors.

[2] Let C be the number of crimes, S the number of crimes solved and, P the number of police. Then $S = a\,C + b\,P$, where a and b are parameters and $0 \leq a \leq 1$. To specify the clearance rate, divide through by C: $\frac{S}{C} = a + b\frac{P}{C}$. The conventional definition requires: $\frac{S}{C} = a + b\frac{P}{POP}$, where POP is population. But $C = f(POP)$ where $f > 0$. Therefore the methods are functionally similar.

been population density. As discussed in the review of the literature (see chapter V, p. 44) population density has been cited as being both a hindrance and an aid to police. Although the direction of the influence is not known a priori, nonetheless it seems plausible that density will indeed affect the efficiency of the police and is therefore included as a predetermined explanatory variables in the production function.

The manpower inputs measure used in this study is total employment of sworn policemen. Clearly some officers can be expected to contribute more to crime deterrence than others; for example, consider the different effect on crime exerted by an additional patrolman versus an additional administrative officer. In an attempt to capture the influence of the 'quality' of inputs, an additional variable is added to the production function. It is the percentage of total manpower actively patrolling the streets in patrol cars. There may of course, be some officers patrolling on foot, but data availability restricts specifications to those in automobiles. It is a priori expected that as the percentage of police actively patrolling increase, the clearance rate will increase. This expectation is based upon the belief that most arrests are made at the scene of the crime (10, p. 66). Since the extent of patrol determines the average response time to a call-for-service it will have a positive influence upon arrests. Although no figures are cited, the Daigneault Report verifies that a "large number of arrests are made by patrolmen in Montréal" (37, p. 46). As specified, the police production function will take the following structural form:

$$(7)\quad CL_{gy} = A_{2y}\ POL_{gy}^{C_1} \cdot CARS_y^{C_2}\ DEN_y^{C_3}\ PAT_y^{C_4}\ \exp.\ u_{2y}$$

$$g = 1, \ldots, m$$
$$y = 1, \ldots, q$$

where:

POL_{gy} = police per crime type 'g' in district 'y'

$CARS_y$ = capital inputs or police cars per policeman in district 'y'

DEN_y = population density in district 'y'

PAT_y = the percentage of total police actively patrolling the streets in district 'y'

A_{2y} = the intercept

and u_{2y} = the disturbance term

The predicted relationships have the following signs:

$$c_1 = \frac{\partial CL_g}{\partial POL_g} > 0 , \quad c_2 = \frac{\partial CL_g}{\partial CARS} > 0 , \quad c_3 = \frac{\partial CL_g}{\partial PAT} > 0 , \text{ and,}$$

$$c_4 = \frac{\partial CL_g}{\partial DEN} \gtrless 0 .$$

In the intracity sample, the conventional demand for protection becomes in effect, a police 'deployment function'. Factors common to conventional demand functions are not applicable in the deployment function and are therefore omitted. For example, wages are the same throughout the entire sample and therefore do not influence the distribution of protection. Likewise, the budget constraint is determined by a single decision maker for the entire sample and will therefore not affect the distribution of resources among districts.

The Daigneault Report (37) has recommended a multiple regression formula for determining police deployment in the MUC. The specification of their equation is as follows:

(8) POLICE = f(DYPOP, DYDEN, COMM, HOMES, CFS, CC)

where:

POLICE = the number of police

DYPOP = the 'dynamic' population

DYDEN = the 'dynamic' population density

COMM = the number of commercial and industrial establishments

HOMES = the number of residential units

CFS = the number of calls for service

CC = the number of Criminal Code violations

(The subscript 'y' has been omitted). The dynamic population and density were calculated by means of taking into consideration movements into and out of each district during the course of a day. Intuitively, this is an important consideration for a metropolitan police force dealing with a large itinerant population.

All variables were specified as absolute magnitudes, no doubt causing serious collinearity problems between HOMES, DYPOP, and CC since all three variables are expected to be strongly correlated. The problems of collinearity could be considerably reduced by normalizing the variables on a population base (i.e., crimes per capita, police per capita, calls per capita, etc.).

The variables CFS and CC represent the response of police to criminal activities ex post, while the remaining four explanatory variables describe police anticipation of crime, ex ante. These four variables (DYPOP, DYDEN, COMM, HOMES) were chosen in consideration of the essential role of the patrolman as indicated in the following passage:

> The police circulates in the streets, discreetly watches the population, buildings, businesses, homes, all possible targets of the criminal... (37, p. 49)

The inclusion of CC in the equation indicates that, from the police perspective, manpower is assigned according to the size of the workload. From the community's point of view, the higher the risk of victimization (i.e., the crime rate) the more it will prefer protection to other commodities and services--the marginal social benefit of

deterring an offence in a high crime district is greater than in a low crime area. A substantial portion of the CC classification includes minor offences the solving of which, only slightly adds to the social benefit. Since the objective of the police is assumed to be minimization of the social cost of crime, their resources would be more effectively deployed among districts according to the comparative levels of serious crimes. The deterrence or clearance of a bank robbery would contribute more to the social welfare function than the solving of a minor shoplifting offence. Since the focus of this study is property crime, this category of offence is used as an indicator of more effective police deployment.

In defining the potential victim stock, the MUC equation employed the variables HOMES and COMM. The necessity of using HOMES is eliminated when crimes are measured on a per capita basis, because the two, (HOMES and population) will be strongly correlated. The non-residential victim stock, COMM, groups all commercial and industrial establisments into a single category. This procedure is open to criticism. Certain businesses (e.g., retail trade) are relatively more attractive victims than others, and should therefore receive a larger amount of protection from the police. The police may be more efficiently assigned according to the concentration of the more susceptible retail stores and not commercial establishments in general.

The allocation of protection should also take into consideration the qualitative appeal of a victim stock. This appeal is a measure of the potential criminal wage. As the wage increases, of course, so will the supply of offences. From the community's perspective, the qualitative appeal represents the potential loss from victimization. As discussed in chapter VIII (p. 60) the expected loss from victimization determines

preferences entering the demand for protection. The proxy employed to represent potential losses from crime in the deployment function is the same as that used to represent the criminal wage in the supply of offences, GAIN.

Employment of the variable DYDEN in the MUC regression can indicate one of two possibilities. First, that the police tend to think in terms of geographical area and, therefore, as the density increases, a given population will be assigned less protection. Or secondly, as population density increases, so does social interaction and, inevitably, crime and the need for police intervention. Unfortunately the police did not specify their justifications for its use. However, based upon previous results (22) a positive relationship is expected.

The deployment of police will also be determined by the demand for services other than those directly related to protection from crime. Data on activities such as emergency services or traffic regulations should be included in the deployment function. The police department neglected to include these services in their regression. Since this data is not available to the public, the all-encompassing variable calls-for-service must be used to measure total workload. It might be argued that CFS and crime rates are strongly correlated, but evidence has been produced to the contrary. Evans cites a study conducted in Montréal which found only 13% of all calls for service to be crime related (10, p. 64). The percentage related to property crime clearly would be much smaller.

The budget constraint or ability to purchase protection has often been included in specifications of the demand for protection (see chapter VI above, p. 46). In the deployment function, all districts face the same budget constraint, therefore its inclusion is unnecessary. However, income could still influence the distribution of protection since

income is believed to determine preferences. Higher income districts would therefore exert more pressure for additional protection from the police.

Based upon these considerations, the deployment function estimated in this paper is of the following structural form:

$$(9) \quad COPS_y = A_{3y}\, PROP_y^{D_1}\, GAIN_y^{D_2}\, STORS_y^{D_3}\, INC_y^{D_4}\, DEN_y^{D_5}\, CALLS_y^{D_6}\, \exp.\, u_{3y}, \qquad y = 1, \ldots, q$$

where the new variables are:

$COPS_y$ = police employment per 1000 population in district 'y'

$PROP_y$ = number of property crimes per 1000 population in district 'y'

$GAIN_y$ = potential loss from victimization in district 'y'

$STORS_y$ = the number of retail stores per 1000 population in district 'y'

$CALLS_y$ = the calls-for-service per 1000 population in district 'y'

A_{3y} = the intercept

u_{3y} = the disturbance term

The predicted relationships are:

$$D_1 = \frac{\partial\ COPS}{\partial\ PROP} > 0\,, \quad D_2 = \frac{\partial\ COPS}{\partial\ GAIN} > 0\,, \quad D_3 = \frac{\partial\ COPS}{\partial\ STORS} > 0\,,$$

$$D_4 = \frac{\partial\ COPS}{\partial\ INC} > 0\,, \quad D_5 = \frac{\partial\ COPS}{\partial\ DEN} > 0\,, \quad D_6 = \frac{\partial\ COPS}{\partial\ CALLS} > 0\,.$$

Since each of the structural equations are overidentified, the Two-Stage Least Squares estimation method is employed giving consistent though not asymptotically efficient results. When used as instrumental variables the endogenous variables are treated as exogenously determined. Three-Stage Least Squares could also have been employed.

CHAPTER X

ESTIMATION RESULTS

The estimation results of the supply of offences--equation (6)--are presented in table 10. The six property crime classifications estimated are: robbery (ROB), breaking and entering (BNE), grand theft (GRAND), petty theft (PETTY), total thefts (THEFT) and property crime (PROP). There are serious criticisms against using the coefficient of determination as an indicator of the explanatory power of an equation estimated by Two Stage Least Squares (see e.g., 38, p. 519). It is therefore not reported in the following tables. In its place the standard error of the regression (SER) and the standard deviation of the dependent variable (SD) are reported.

The results are generally satifactory but in some cases mixed. The coefficient for the clearance rate CL, has the predicted negative relationship and is significant for the more serious offences of ROB, BNE and total property crime, supporting the view that police output is a deterrent to crime. In the three theft categories the coefficient is insignificant but, nonetheless, of the anticipated sign. The possibility that police do not provide as strong a deterrent to petty theft relative to the more serious crimes is not totally unexpected. Criminals are less likely to invest as much calculation and planning in petty thievery as they would in the more serious offences where the punishment is more severe. The efficiency of police would therefore not receive as much consideration in the decision to commit these crimes. In addition, the fact that the clearance rates for ROB and BNE refer only to clearances by arrest while the rate used for thefts refers to total clearances (by arrest or otherwise) may

TABLE 10

TWO-STAGE LEAST SQUARES REGRESSION RESULTS
FOR THE SUPPLY OF OFFENCES
(t-values in parentheses)

OFFENCE	A_1	CL_g	BOYS	ONE	INC	GAIN	SPIL	SER	SD
ROB	21.00 (2.33)**	-1.75 (-2.46)**	4.34 (1.46)	0.06 (0.03)	0.31 (0.23)	-0.91 (-2.08)**	-0.52 (-1.94)*	1.14	1.09
BNE	12.03 (1.52)	-1.37 (-2.05)**	0.61 (0.43)	3.09 (2.59)**	3.54 (2.00)**	-0.94 (-1.40)	-0.11 (-0.52)	.74	.65
GRAND	-3.50 (-0.93)	-0.49 (-1.45)	-0.48 (-0.40)	1.81 (2.54)**	0.70 (1.00)	0.63 (3.15)***	0.17 (0.75)	.64	.74
PETTY	-9.80 (-2.75)***	-0.22 (-0.64)	-1.92 (-1.68)*	1.39 (2.07)**	-0.18 (-0.27)	0.91 (4.86)***	0.09 (0.42)	.60	.84
THEFT	-6.10 (-1.84)*	-0.37 (-1.23)	-1.28 (-1.20)	1.48 (2.37)**	0.23 (0.38)	0.75 (4.28)***	0.14 (0.70)	.57	.72
PROP	-5.54 (-1.76)*	-0.67 (-1.77)*	-0.61 (-0.63)	1.93 (3.03)***	0.66 (1.09)	0.67 (3.98)***	0.20 (1.34)	.51	.61

*** significant for a two-tailed test at the 1% level
** significant for a two-tailed test at the 5% level
* significant for a two-tailed test at the 10% level

be partial explanation for the insignificant coefficients. As discussed in the previous chapter, total clearances may not accurately reflect the criminal's subjective probability of failure. The elasticities of the two most serious property offences, ROB and BNE, are much larger than one, indicating a strong response from the criminal community to variations in the clearance rate.

The coefficients of the unemployment variable, UNE, consistently display the expected sign, and are significant in all cases but one, ROB. The fact that UNE has an insiginficant influence upon ROB may be due to a lag effect. If new entrants to the illegal market begin their criminal careers with less serious crimes and only after the accumulation of experience begin to commit the more serious offences of burglary and robbery, then only the supply of less serious offences can be expected to be influenced by present unemployment levels. ROB, being the most serious of property crimes, would be determined by unemployment rates lagged an additional period. In the present data, all crimes pertain to 1972 and the unemployment rate to 1971. Although unintended, the data may be introducing a lag specification to the model. If UNE does have a lagged effect, then its strongest influence should be after one year, when unemployment insurance benefits run out. As the length of unemployment increases, and the frustration of not finding legal employment sets in, discouraged workers begin entering criminal occupations, starting perhaps with thefts or BNE's and eventually graduating to robbery. Unfortunately, testing this hypothesis with unemployment rates from different years was impossible because the data is available only for 1971. This is especially disappointing since in the remaining five categories of crime, the unemployment rate has elasticities much larger than one, indicating a strong response from the criminal community

to employment opportunities.

The results regarding the effect of labour market conditions on crime have been mixed in the U.S. studies (see above, p. 31). However, the strong statistical relationship found in this paper refute the findings of two previous studies employing Canadian data (10, 21). Perhaps the different conclusions could be attributed to the different samples. The two studies that found a weak and mixed relationship between unemployment and crime used national and provincial data, whereas this study employs an urban sample. National and provincial samples include a large rural element where the repercussions of unemployment may be weaker than in the city. Also, the expected income from crime may be relatively lower in rural areas as the lower degree of anonymity will increase the probability of arrest. Although employment opportunities have been shown in this paper to be a significant determinant of the supply of offences, this relationship may be restricted to urban areas.

The results of the variable attempting to capture the influence of youthful males are mixed. In only two instances, ROB and BNE, are the coefficients of the expected sign although insignificant. Curiously, BOYS displays the anticipated influence for the more serious offences when the a priori expectation would be the opposite i.e., that the youth contribute more to less serious offences. Two explanations are possible: (1) that young male criminals do indeed specialize in the more serious property crimes, or (2) the young have a relatively larger propensity to be arrested and convicted and therefore, the conviction data in chapter II (above, p. 18) does not accurately reflect their share of total offences. However puzzling, mixed results employing the same variable (but as a percentage total 'male' population) were also found by the other Canadian study, Avio & Clark (21), while the U.S.

studies generally found a strong and positive relationship (see above, p. 34). Perhaps unlike their counterparts in the U.S., young males in Canada are not responsible for disproportionate shares of property crime.

The proxy variable employed to represent potential criminal wage, GAIN, performs reasonably well; its coefficients have the expected sign and are significant at the 99% confidence level in four offence classifications. However, they are of the opposite sign for the more serious crimes, ROB and BNE and significant at the 90% level of confidence in the former case. The negative signs would be acceptable for the less serious offence of petty theft as these criminals are likely to display a relatively weaker response to the costs and benefits of crime.

The coefficients of the proxy variable SPIL, attempting to account for spillovers of crime among adjacent districts, have negative signs in both serious offence categories, ROB and BNE, although only one is statistically significant. The insignificant signs for the less serious offences of theft are not surprising since criminals in these categories are less likely to have information on adjacent districts and even if so, less likely to respond to it, because the additional costs of committing these crimes in adjacent districts may outweigh any increases in the expected net gain produced by a lower risk factor. The fact that both serious offences have the same sign and all the less serious crimes have the opposite sign, suggests that the proxy SPIL is explaining part of the tendency for crimes to spillover. However, this proxy only considers intracity differences in clearance rates as a cause of spillovers, while clearly other factors such as differences in the criminal wage among districts could also influence spillovers. Further research on the nature and extent of intracity spillovers of crime is recommended.

In only one regression, PETTY, did the variable representing

the opportunity cost of crime assume the anticipated sign. As alluded to in chapter VII (see above, p. 33), the poor performance by INC may be due to the possibility that is represents not only opportunity cost, but also potential gain from crime. As pointed out in chapter VII, this problem is likely to be more prevalent for the more serious offences because of their stronger tendency to spillover into other districts. The offence expected to have the least amount of spillover, PETTY, is the only regression in which the coefficient displays the expected negative sign, supporting the belief that the INC variable is actually representing the appeal of a larger criminal wage presented by wealthier victims. In addition, the explanatory power of INC is weakened by collinearity with UNE and GAIN. It is believed that the poor results are due to data or statistical problems, and not in the underlying theory itself.

The results of the estimates of the production of crime deterrence are presented in table 11 for four output measures, the clearance rates for: robbery (CLROB), breaking and entering (CLBNE), theft (CLTHEFT) and, property crime (CLPROP).

The coefficients of the variable representing manpower inputs are of the predicted sign for CLBNE and CLTHEFT--the former of which is significant at the 99% confidence level. The coefficients are negative in the two remaining cases, but insignificant. As was discovered during the writing of this paper, a subset of the robbery classification, 'armed robbery', is not investigated at the local district level but at a central level for the entire MUC. Therefore investigative inputs at the local level would have no influence on the incidence of armed robbery which may represent a large proportion of total robberies.

The actual function of manpower inputs is, as anticipated, an important determinant of the output of the police as demonstrated by the

TABLE 11

TWO-STAGE LEAST SQUARES REGRESSION RESULTS
OF POLICE PRODUCTION FUNCTION
(t-values in parentheses)

OUTPUT	A_2	POL_g	CARS	DEN	PAT	SER	SD
CLROB	2.35 (0.77)	-1.52 (-1.11)	-.09 (-0.07)	-0.67 (-1.49)	0.62 (0.54)	1.34	.75
CLBNE	-0.47 (-0.56)	1.29 (5.89)***	-0.01 (-0.02)	0.22 (1.30)	0.56 (1.30)	.58	.78
CLTHEFT	-0.73 (-0.53)	0.05 (0.24)	-2.01 (-2.59)**	0.03 (0.12)	1.13 (1.89)*	.79	.84
CLPROP	-4.80 (-4.60)***	-0.15 (-0.90)	-1.39 (-2.38)**	0.10 (0.64)	0.88 (2.01)**	.59	.60
CLROB	2.58 (0.99)	-1.58 (-1.10)	-	-0.68 (-1.49)	0.59 (0.67)	1.39	.75
CLBNE	-0.48 (-1.58)	1.28 (5.89)***	-	0.21 (1.30)	0.55 (1.84)*	.57	.78
CLTHEFT	2.42 (5.13)***	0.14 (0.17)	-	0.05 (0.23)	-0.03 (-0.08)	.86	.84
CLPROP	-2.66 (-5.79)***	-0.08 (-0.45)	-	0.12 (0.74)	0.11 (0.36)	.62	.60

*** significant for a two-tailed test at the 1% level
** significant for a two-tailed test at the 5% level
* significant for a two-tailed test at the 10% level

proxy, PAT (the percentage of total police actively patrolling in automobiles). It consistently displays the expected relationship and is significant in two of the four regressions, reinforcing the belief that the act of patrolling significantly contributes to police output.

The performance of the proxy intended to represent capital inputs at the district level CARS, is singularly disappointing. It has the undesired relationship in each regression, and is significant in two. It would appear that CARS is a poor measurement of non-human resources for disaggregated samples, but a more suitable measurement could not be obtained. Fearing that the inclusion of CARS may be producing spurious results in other variables, the equations were re-estimated without the CARS variable. As shown in the lower half of table 11, the only remaining coefficients that significantly changed are those for PAT variable which lose significance in the CLTHEFT and CLPROP equations, but gain significance in CLBNE.

The relationship between population density and police output is significant in only one case, CLROB, in which the sign is negative, lending support to Jacobs' argument (see chapter V above, p. 44). However, the remaining three positive and insignificant relationships prevent any conclusive interpretation of the effect of density on police output.

The results of simultaneous estimation of the police deployment function are as follows:

(10) COPS = -3.03 + .18 PROP - .32 GAIN + .25 STORS
(-1.52) (.57) (-1.69)* (1.91)*

+ .43 INC + .08 DEN + .90 CALLS
(1.65)* (1.73)* (5.21)***

and, SER = .27 S.D. = .64

The results are generally satisfactory with only the criminal wage, GAIN,

behaving contrary to expectations. The only insignificant variable is the risk of victimization, PROP. This offence category is admittedly, a weak indicator of efficient police deployment since it does not include serious crimes of violence. It was nonetheless retained in the equation because of the topic of this study. The relationship, though not significant, is as predicted, positive. The only variable displaying a significant influence at the 99% level of confidence, is the number of calls for service, CALLS. It would appear that deployment is determined more by the provision of total police services than by solely their function of crime prevention. This variable also has the largest elasticity of .90 (note that it is favourably less than one). The MUC police have recently announced that they are ceasing to supply response to calls for several minor thefts, domestic disputes and minor traffic mishaps (39). This reduction will likely enable the police to devote more time to patrol related activities which have been shown to contribute to the output of clearances. However, the long run costs of further isolating the police from the community are unknown. In any case, in view of this policy change the deployment of manpower is likely, in the future, to be more responsive to the risk of victimization.

The coefficient for population density, DEN, is positive and significant, indicating that police do not necessarily deploy manpower in reference to geographical area. As social interaction increases, so does the intensity of the police presence. It is unfortunate that the required data is not available to ascertain how much of this increased presence is due to the increased need for traffic regulation.

The results for the variables STORS and INC are as predicted, and significant. The concentration of the level of retail stores and income are used by the police as indicators for manpower deployment. Whether

this is due to the police anticipating crime or by the pressure exerted by these groups for additional protection" is unknown.

PART V

SUMMARY AND CONCLUSIONS

CHAPTER XI

SUMMARY AND CONCLUSIONS

Property crime has been shown to impose sizable costs upon its individual victims and considerable welfare losses upon society as a whole. It was also determined that property crime presented special problems with respect to its extent, growth and distribution.

The objective of this study has been to provide an economic explanation of property crime, an analysis of households' response to it and, an examination of the effectiveness of the police in their role of crime prevention. A critical review of the literature identified those topics requiring further research. It was found that two areas in particular required further development. The first, a restatement of the theory, demanded a more precise definition of the functional interaction of each of the three essential segments of the crime market: the criminals, the victims and the police. Secondly, a blatant shortage of empirical work in the economics of crime employing disaggregated or Canadian data was discovered.

A three-equation model depicting the supply of offences, the police production function and, the demand for protection was formulated. The supply of offences was specified as a function of the probability of failure at crime, the cost of participating in crime and the expected income from crime. The production of crime deterrence was defined as being determined by police inputs and environmental constraints. The demand for protection was specified as a function of the risk of victimization, preferences and the budget constraint. The number of

crimes, the output of police and the number of police were specified as simultaneously determined.

The model was estimated employing the urban sample of police districts in the Montréal Urban Community. Intracity samples were identified as posing the special problem of spillovers in crime among the various districts. The few previous studies using intracity samples failed to adequately deal with the problem. A proxy variable approximating the extent of spillovers was formulated and included in the supply of offences. Its performance conformed to a priori expectations: spillovers are more prevalent as the seriousness of the offence increases. An additional proxy variable, representing the criminal wage, was defined. Its results can be considered a significant improvement over previous proxies employed in this area.

The results of the supply of offences tend to confirm that criminals behave in a manner consistent with economic theory, i.e., rationally. Given the costs and benefits of participation in illegitimate activities, they will allocate their time between legal and illegal labour markets with the objective of maximizing expected utility. Estimation of the production of crime deterrence produced mixed and often insignificant results. Of the four variables employed, the activity of police patrol was the only contributor to police output. Further refinement of the police production function, especially for a single department, is required. The results of the demand for protection generally conformed to expectations without any surprising findings.

In view of the behaviour of criminals, public policy should be directed at minimizing the social cost of crime by altering the costs and benefits of crime. The expected income from crime will be significantly reduced by increasing the probability of arrest. Property crime offenders

have been shown to respond as anticipated to variations in this risk factor. However, the results concerning the production of deterrence are inconclusive and any recommendations regarding the method of increasing police output would therefore be tentative. In other words, although crimes against property will be reduced by increases in the output of deterrence, given the results of this paper, the increases in output do not necessarily follow from increases of inputs of police manpower or equipment.

The strongest and most unambiguous influence on crime was shown to be exerted by the unemployment rate. A one percent decrease in the unemployment rate can be expected to reduce property crime by 1.93%. Policy makers would be well advised to consider the unemployment rate as an alternative instrument to deterrence in reducing crime. Further research into the costs and benefits of utilizing the unemployment rate as an instrument in obtaining the optimal level of crime would seem worthwhile. This is especially true at the level of local government where crime is a more serious problem and employment policy has largely been considered the responsibility of higher levels of government and thus, to date, ignored.

APPENDICES

APPENDIX A

TO DEMONSTRATE RISK AVERSION

The expected utility is dependent upon the four possible states of the world as already defined:

$$(A.1) \quad E(U) = (1-p)(1-u)U_A + p(1-u)U_B + (1-p)\,u\,U_C + pu\,U_D$$

where:

$$U_A = U\left[W_L\,t_L + W_c\,t_c\right]$$

$$U_B = U\left[W_L\,t_L + kW_c\,t_c - L\right]$$

$$U_C = U\left[W_c\,t_c\right]$$

$$U_D = U\left[kW_c\,t_c - L\right]$$

Let the amount of total working time t, be given and fixed and that

$$t = t_L + t_c$$

$$t_L = t - t_c$$

Substituting:

$$U_A = U\left[W_L\,(t - t_c) + W_c\,t_c\right]$$

$$U_B = U\left[W_L\,(t - t_c) + kW_c\,t_c - L\right]$$

$$U_C = U\left[W_c\,t_c\right]$$

$$U_D = U\left[kW_c\,t_c - L\right]$$

Taking the first order derivative of (A.1) with respect to t_c and setting it equal to zero, the first order condition for a maximum will be:

$$(A.2) \quad \frac{d\,E(U)}{d\,t_c} = (1-p)(1-u)U_A'(-W_L + W_c) + p(1-u)U_B'(-W_L + kW_c) + (1-p)u\,U_C'(W_c) + pu\,U_D'(kW_c) = 0$$

$$(A.3) \quad \frac{W_L}{W_c} = \frac{(1-p)(1-u)\,U'_A + p(1-u)^k\,U'_B + (1-p)\,uU'_C + p\,u^k\,U'_D}{(1-p)(1-u)U'_A + p(1-u)\,U'_B}$$

The second order condition for a maximum requires that:

$$(A.4) \quad \frac{d^2\,E(U)}{dt_c^{\,2}} = (1-p)(1-u)\,U''_A\,(-W_L + W_c)^2 + p(1-u)\,U''_B\,(-W_L + kW_c)^2 + (1-p)u\,U''_C\,(W_c)^2 + p\,u\,U''_D\,(kW_c)^2 < 0$$

In order for (A.4) to be satisfied, it is sufficient that U''_A, U''_B, U''_C, $U''_D < 0$. That is to say, the marginal utility of income is diminishing which implies risk aversion.

APPENDIX B

SOURCE AND CALCULATION OF REGRESSION VARIABLES

The sample required data disaggregated to the level of the 38 police districts in the MUC. Crime and police data are available by police districts in various MUC publications, but socioeconomic information is not published at this level. Since suburban municipalities typically constitute entire police districts, data for these observations were readily available. For the 16 police districts in the City of Montréal variables had to be calculated by aggregating the information available at the census tract level. Statistics Canada has defined 291 census tracts in the City of Montréal, these were allocated to the appropriate police districts. District and tract boundaries coincided approximately 95% of the time. The remainder was arbitrarily assigned according to comparibility with adjacent tracts. Variables representing absolute magnitudes required simple summation while for those representing averages, appropriate weighting schemes had to be chosen. The following is a list of the sources and, when applicable, their calculation.

The total population, POP; the percentage of males, 15 years and older, in the labour force and unemployed, UNE; the percentage of the population male, 15-24 years old; Statistics Canada, 1971 Census of Canada--Population and Housing Characteristics by Census Tracts--Montréal, Catalogue 95-734, Series A and B.

The number of retail stores per 1000 population, STORS; the average sales per retail store, SALES; Statistics Canada, 1966 Census of Canada, Retail Trade--Metropolitan Areas, Catalogue 97-604.

The offence rates per 1000 population, ROB,BNE,GRAND, and PETTY; the clearance rates by arrest CLROB, CLBNE; the clearance rate by arrest or otherwise, CLTHEFT; the number of police per 1000 population, COPS; the number of police per crime, POL; the number of calls-for-service per 1000 population, CALLS;Communauté Urbaine de Montréal, Service de Police, Données Statistiques, 1972. (N.B.--For suburban observations, GRAND and PETTY were obtained from: Statistics Canada, Crime and Traffic Enforcement Statistics, Catalogue 85-205, 1972-1973)

The number of patrolcars, ambulances and unmarked cars per 1000 population, CARS; the percentage of total police actively patrolling the streets in cars, PAT; Communauté Urbaine de Montréal, Service de Police, Allocation of the Human and Material Resources, prepared under the direction of René Daigneault, Director, March 1974.

The median property value of single detached dwellings, VALUE: Statistics Canada, 1971 Census of Canada, Catalogue 95-734, Series B. For the jth

police district in the City of Montréal, this variable was calculated by:

$$VALUE_j = \frac{\sum_{i=1}^{n} (SINGLES)_i \ (value)_i}{\sum_{i=1}^{n} (SINGLES)_i}$$

where:

$value_i$ = the median property value of single detached dwellings in census tract i

$SINGLES_i$ = the number of single detached dwellings in census tract i

n = the number of census tracts in the j^{th} police district

Average household income, INC: Statistics Canada, 1971 Census of Canada, Catalogue 95-734, Series B. For the jth police district in the City of Montréal, this variable was calculated by:

$$INC_j = \frac{\sum_{i=1} (inc)_i \ (HH)_i}{\sum_{i=1}^{n} (HH)_i}$$

where:

inc_i = the average household income in census tract i

HH_i = the number of households in census tract i

n = the number of census tracts in the j^{th} police district

The population per square mile, DEN: Statistics Canada, 1971 Census of Canada, Geography--Land Areas and Densities, Catalogue 98-701. For police districts in the City of Montréal, this variable was calculated by:

$$DEN_j = \frac{\sum_{i=1}^{n} (den)_i}{n}$$

where:

den_i = the population per square mile in census tract i

n = the number of census tracts in the j^{th} police district

In order to calculate the spillover of crime for the ith district, $SPIL_i$, the following groups of districts were visually identified as being immediately adjacent to the ith, and therefore constituting its contiguous community:

CONTIGUOUS COMMUNITIES

i	ADJACENT DISTRICTS	i	ADJACENT DISTRICTS
3	6,7,16,18,21,29,	13	2,14,31,33,34,35
4	6,9,10,16,17	22	21,28,29
6	3,4,7,16	23	2,24,35,36
7	3,6,27,28	24	23,25,36,37,39
9	4,10,11,12	25	24,36,38,39
10	4,9,15,5,17,30	26	21,27
12	9,11,14,30,32	27	7,21,26,28
14	12,13,15,30,33,34	28	7,21,22,27,29
15	1,5,10,14,30,33	29	3,7,21,22,28
16	3,4,6,17,18	30	10,12,14,15
17	4,5,10,16,18	31	12,13,34,35
18	1,3,5,16,17,19,21	32	11,12,31,35
19	1,2,18,20,21	33	1,13,14,15
20	2,19,21,25	34	12,13,14,31,35
21	3,18,19,20,22,29	35	2,13,23,31
1	2,5,15,18,19,33	36	2,23,24,25
2	1,13,19,20,23,25,35	37	24,39
5	1,10,15,17,18	38	39,25
11	9,12,32	39	24,25,37,38

APPENDIX C

ESTIMATION RESULTS EMPLOYING CONVENTIONAL DEFINITION OF POLICE INPUTS

Presented in tables C-1 and C-2 are the estimation results of the supply of offences and the production function employing the conventional definition of police inputs--police per capita--as opposed to 'police per crime' employed in the text.

The only striking changes in the supply of offences are found in the coefficients for the variables CL and SPIL. The signs of the CL coefficients change in the three theft categories and lose their significance in the ROB and BNE regressions. Four of the six coefficients for SPIL change signs, although only one is significant. However, the main policy conclusion reached in this paper, the effect of UNE on crime is still positive and significant in every instance.

The results of the police production function are still generally disappointing. The relationship between police inputs and output is positive, but significant for only robberies and breaking and enterings. The patrol activity maintains its positive and usually significant influence on police output, as indicated by the coefficients of PAT.

TABLE C-1

2SLS REGRESSION RESULTS OF SUPPLY OF OFFENCES
EMPLOYING COPS (POLICE PER CAPITA)
(t-values in parentheses)

OFFENCE	A_1	CL_g	BOYS	UNE	INC	GAIN	SPIL	SER	SD
ROB	9.06 (1.58)	-0.40 (-0.91)	0.18 (0.10)	2.78 (2.32)**	1.48 (1.69)*	-0.41 (-1.47)	-0.17 (-1.04)	.76	1.09
BNE	-1.18 (-0.28)	-0.05 (-0.14)	-0.41 (-0.49)	1.37 (2.06)**	0.38 (0.41)	0.31 (0.89)	0.22 (1.91)*	.45	.65
GRAND	-5.03 (-1.65)*	0.11 (0.50)	-1.22 (-1.26)	1.65 (2.84)***	0.38 (0.68)	0.64 (3.99)***	-0.18 (-1.15)	.52	.74
PETTY	-10.80 (-3.40)***	0.18 (0.79)	-2.41 (-2.39)**	1.28 (2.12)**	-0.39 (-0.67)	0.93 (5.46)***	-0.13 (-0.84)	.55	.84
THEFT	-7.39 (-2.68)***	0.14 (0.70)	-1.90 (-2.17)**	1.35 (2.57)***	-0.04 (-0.07)	0.77 (5.23)***	-0.16 (-1.09)	.48	.72
PROP	-3.64 (-1.49)	-0.06 (-0.24)	-1.16 (-1.55)	1.45 (2.98)***	0.23 (0.49)	0.58 (4.39)***	0.01 (0.10)	.40	.61

*** significant for a two-tailed test at the 1% level
** significant for a two-tailed test at the 5% level
* significant for a two-tailed test at the 10% level

TABLE C-2

2SLS REGRESSION RESULTS OF POLICE PRODUCTION FUNCTION
EMPLOYING COPS (POLICE PER CAPITA)
(t-values in parentheses)

OUTPUT	A_2	COPS	CARS	DEN	PAT	SER	SD
CLROB	0.15 (0.17)	0.45 (1.78)*	0.46 (0.76	-0.19 (-1.04)	0.30 (0.65)	.60	.75
CLBNE	-0.79 (-0.88)	1.16 (4.40)***	1.19 (1.78)*	0.28 (1.46)	0.85 (1.77)*	.62	.78
CLTHEFT	-0.59 (-0.52)	0.33 (1.01)	-1.71 (-2.18)**	0.15 (0.63)	1.36 (2.25)**	.78	.84
CLPROP	-4.04 (-4.86)***	0.17 (0.71)	-0.98 (-1.68)*	0.20 (1.10)	0.92 (2.09)**	.57	.60

*** significant for a two-tailed test at the 1% level
** significant for a two-tailed test at the 5% level
* significant for a two-tailed test at the 10% level

REFERENCES

LIST OF CITATIONS

(1) Tullock, Gordon. The Logic of the Law. New York: Basic Books, 1971.

(2) Hadar, Josef. Mathematical Theory of Economic Behaviour. Reading (Mass.): Addison-Wesly Publishing Company, Inc., 1971.

(3) Henderson, James M. and Richard E. Quandt. Microeconomic Theory: A Mathematical Approach. 2d ed. New York: McGraw-Hill Inc., 1971.

(4) Québec. Commission of Enquiry into the Administration of Justice on Criminal and Penal Matters in Québec. Crime, Justice and Society. 9 vols. Québec Official Publisher, 1969. Vol. 3, tome 1, "Crime in Québec: Trends in Québec Criminality." (hereafter cited as The Commission of Enquiry)

(5) Statistics Canada. Crime and Traffic Enforcement Statistics. Catalogue 85-205, 1972-1973.

(6) U.S. Department of Justice. Law Enforcement Administration, National Institute of Law Enforcement and Criminal Justice. Evaluation of Crime Control Programs, by Micheal D. Maltz. Washington, D.C.: Government Printing Office, April 1972.

(7) U.S. The President's Commission on Law Enforcement and Administration of Justice. Task Force Report: Crime and Its Impact--An Assessment. Washington, D.C.: Government Printing Office, 1967. (hereafter cited as The President's Commission)

(8) Swimmer, Eugene. "Measurement of the Effectiveness of Urban Law Enforcement--A Simultaneous Approach." Southern Economic Journal 40 (April 1974): 618-30.

(9) Cebula, Richard J. and Paul K. Gatons. "Potential Theft as Indirect Taxation: A Brief Note." Public Choice 20 (Winter 1974): 109-111.

(10) Economic Council of Canada. Developing Policies for Public Security and Criminal Justice, by Robert Evans Jr. Special Study No. 23. Ottawa: Information Canada, 1973.

(11) Tullock, Gordon. "The Welfare Costs of Tariffs, Monopolies and Theft." Western Economic Journal (June 1967): 224-32.

(12) Becker, Gary S. "Crime and Punishment: An Economic Approach." Journal of Political Economy 76 (March/April): 169-217.

(13) Kau, James B. and Paul H. Rubin. "New Estimates of the Determinants of Urban Crime." Annals of Regional Science 9 (March 1975): 68-76.

(14) Chapman, Jeffery I. "The Impact of Police on Crime and Crime on Police: A Synthesis of the Economic and Ecological Approaches." Institute of Government and Public Affairs, UCLA, 1973.

(15) Church, Albert M. "Minimizing the Cost of Crime." Ph.D. dissertation, Dept. of Economics, Claremont Graduate School, 1970.

(16) Sjoquist, David Lawrence. "Property Crime and Economic Behaviour: Some Empirical Results." American Economic Review 63 (June 1973): 439-46.

(17) Streeter, Lanny and Robert Terpstra. "An Empirical Study of the Socio-Economic Determinants of Property Crimes and the Relative Impact of Law-Enforcement Efforts." Paper presented to the Western Economic Association, June 1974.

(18) Erhlich, Isaac. "Participation in Illegitimate Activities." Journal of Political Economy 81 (May/June 1973): 521-65.

(19) Mehay, Stephen L. "The Production of Crime Deterrence by Urban Police Departments." Working Paper No.23, Concordia University (Montréal), 1974.

(20) Reynolds, Morgan. "Crimes for Profit: The Economics of Theft." Ph.D. dissertation, Dept. of Economics, University of Wisconsin, 1971.

(21) Avio, Kenneth L. and C. Scott Clark. Property Crime in Canada: An Econometric Study. Ontario Economic Council Research Study. University of Toronto Press, 1976.

(22) Carr-Hill, R.A. and N.H. Stern. "An Econometric Model of the Supply and Control of Recorded Offences in England and Wales." Journal of Public Economics 2 (Nov. 1973): 289-318.

(23) Conley, Bryan. "Economic, Sociological and Racial Factors in Juvenile Property Crime." n.p. 1974. (Mimeographed.)

(24) Pogue, Thomas F. "Effects of Police Expenditures on Crime Rates: Some Evidence." Public Finance Quarterly 3 (Jan. 1975): 14-44.

(25) Thaler, Richard. "An Econometric Analysis of Property Crime: Interaction Between Police and Criminals." Working Paper No. 7441, Graduate School of Management, University of Rochester, 1974.

(26) Phillips, Llad, Harold L. Votey and Darold Maxwell. "Crime, Youth and the Labour Market." Journal of Political Economy 80 (May/June 1972): 491-504.

(27) Orsagh, Thomas. "Crime, Sanctions and Scientific Explanation." Journal of Criminal Law and Criminology 64 (1973): 354-61.

(28) Grieson, Ronald E. " The Determinants of Juvenile Arrests." Working Paper 87, Dept. of Economics, MIT, July 1972.

(29) Morris, Douglas and Luther Tweeten. "The Cost of Controlling Crime: A Study in the Economics of City Life." Annals of Regional Science (June 1971): 33-49.

(30) McPheters, Lee R. and William B. Stronge. "Law Enforcement Expenditures and Urban Crime." National Tax Journal 47 (Dec. 1974): 633-44.

(31) Cho, Yong Hyo. "A Multiple Regression Model for Measurement of Policy Impact on Big City Crime." Policy Sciences 3 (1972): 435-53.

(32) Theil, Henri. Linear Aggregation of Economic Relations. Amsterdam: North-Holland Publishing Company, 1965.

(33) Block, Micheal K. "Theft: An Econometric Study." Paper presented to the Second Interamerican Congress of Criminology, Caracas, Nov. 1972.

(34) Shoup, Carl S. "Standards for Distributing a Free Governmental Service: Crime Prevention." Public Finance 19 (1964):383-92.

(35) Jacobs, Jane. The Death and Life of Great American Cities. New York: Vintage Books, 1961.

(36) Greenwood, Micheal J. and Walter J. Wadychi. "Crime Rates and Public Expenditures for Police Protection: Their Interaction." Review of Social Economy 31 (Oct. 1973):138-52.

(37) Communauté Urbaine de Montréal. Service de Police. Allocation of the Human and Material Resources. Prepared under the direction of René Daigneault, Director. March 1974. (hereafter cited as The Daigneault Report)

(38) Christ, Carl F. Econometric Models and Methods. New York: John Wiley and Sons, Inc., 1966.

(39) The Montréal Gazette, June 18, 1976.

LIST OF STATISTICAL SOURCES

Communauté Urbaine de Montréal. Service de Police. Données Statistiques. 1972-1974.

_____. Allocation of the Human and Material Resources. Prepared under the direction of René Daigneault. March 1974.

_____. Conseil de Sécurité. Sommaire Statistique. 1974.

Statistics Canada. Local Government Finance. Catalogue 68-204. Ottawa: Information Canada, 1962-1972.

_____. Provincial Government Finance. Catalogue 68-207. Ottawa: Information Canada, 1962-1972.

_____. Federal Government Finance. Catalogue 68-211. Ottawa: Information Canada, 1961-1971.

_____. 1966 Census of Canada, Retail Trade--Metropolitan Areas. Catalogue 97-604. Ottawa: Information Canada.

_____. Crime and Traffic Enforcement Statistics. Catalogue 85-205. Ottawa: Information Canada, 1965-1974. (Prior to 1972 entitled "Crime Statistics")

_____. 1971 Census of Canada, Population and Housing Charteristics--Montréal. Catalogue 98-734, Series A and B. Ottawa: Information Canada.

_____. 1971 Census of Canada, Geography--Land Areas and Densities. Catalogue 98-701. Ottawa: Information Canada.

_____. Statistics of Criminal and Other Offences. Catalogue 85-201. Ottawa: Information Canada, 1972.

_____. Juvenile Delinquents. Catalogue 85-202. Ottawa: Information Canada, 1972.

_____. Vital Statistics, vol. 1 "Births". Catalogue 84-202. Ottawa: Information Canada, 1973.

_____. Law Enforcement, Judicial and Correctional Statistics, Service Bulletin vol. 3 no.11, "Comparison of Crime Index Offence Rates, Canada and U.S., 1973." Catalogue 85-001. Ottawa: Information Canada, May 1975.

Toronto. Metropolitan Toronto Police. Annual Statistical Report, 1972.

U.S. The President's Commission on Law Enforcement and Administration of Justice. Task Force Report: Crime and Its Impact--An Assessment. Washington, D.C.: Government Printing Office, 1967.

BIBLIOGRAPHY

Avio, Kenneth L., and C. Scott Clark. Property Crime in Canada: An Econometric Study. Ontario Economic Council Research Study. University of Toronto Press, 1976.

Becker, Gary S. "Crime and Punishment: An Economic Approach." Journal of Political Economy 76 (March/April, 1968): 169-217.

Bell-Rowbotham, Beverly and Craig L. Boydell. "Crime in Canada: A Distributional Analysis." Deviant Behaviour and Societal Reaction. ed. Craig L. Boydell, Carl F. Grindstaff and Paul C. Whitehead. Toronto: Holt, Rinehart and Winston of Canada, Limited, 1972: 93-116.

Block, Michael K. "Theft: An Econometric Study." Paper presented to the Second Interamerican Congress of Criminology, Caracas, Nov. 1972.

_____ and J.M. Heineke. "A Labor Theoretic Analysis of the Criminal Choice." American Economic Review 65 (June 1975): 314-25.

Brown, William W. and Morgan O. Reynolds. "Crime and Punishment: Risk Implications." Journal of Economic Theory 8 (1973): 508-514.

Canada. Department of the Solicitor General. The Cost of Crime and Crime Control. Prepared under the direction of Denis Szabo. Ottawa: Information Canada, 1971.

Carr-Hill, R.A., and N.H. Stern. "An Econometric Model of the Supply and Control of Recorded Offences in England and Wales." Journal of Public Economics 2 (Nov. 1973): 289-318.

Cebula, Richard J. and Paul K. Gations. "Potential Theft as Indirect Taxation." Public Choice 20 (Winter 1974): 109-111.

Chapman, Jeffrey I. " The Impact of Police on Crime and Crime on Police: A Synthesis of the Economic and Ecological Approaches." Institute of Government and Public Affairs, UCLA, 1973.

Cho, Yong Hyo. "A Multiple Regression Model for Measurement of Policy Impact on Big City Crime." Policy Sciences 3 (1972): 435-453.

_____. Public Policy and Urban Crime. Ballinger Publishing Co. 1974.

Christ, Carl F. Econometric Models and Methods. New York: John Wiley and Sons, Inc., 1966.

Church, Albert M. "Minimizing the Cost of Crime." Ph.D. dissertation, Dept. of Economics, Claremont Graduate School, 1970.

Communauté Urbaine de Montréal. Service de Police. Allocation of the Human and Material Resources. Prepared under the direction of René Daigneault, Director. March 1974.

Conley, Bryan. "Economic, Sociological and Racial Factors in Juvenile Property Crime." n.p. 1974. (Mimeographed.)

Economic Council of Canada. Developing Policies for Public Security and Criminal Justice, by Robert Evans Jr. Special Study No. 23, 1973.

Erhlich, Isaac. "Participation in Illegitimate Activities." Journal of Political Economy 81 (May/June 1973): 521-565.

Greenwood, Michael J. and Walter J. Wadycki. "Crime Rates and Public Expenditures for Police Protection: Their Interaction." Review of Social Economy (October 1973): 138-152.

Grieson, Ronald E. "The Determinants of Juvenile Arrests." Working Paper 87. Dept. of Economics, MIT, July 1972.

Hadar, Josef. Mathematical Theory of Economic Behaviour. Reading (Mass): Addison-Wesley Publishing Company Inc., 1971.

Henderson, James M., and Richard E. Quandt. Microeconomic Theory: A Mathematical Approach. 2d ed. New York: McGraw-Hill Book Company, Inc., 1971.

Hirsch, Werner Z. Urban Economic Analysis. New York: McGraw-Hill Book Company, 1973.

Hoch, Irving. "Factors in Urban Crime." Journal of Urban Economics 1 (April 1974): 184-229.

Jacobs, Jane. The Death and Life of Great American Cities. New York: Vintage Books, 1961.

Kau, James B. and Paul H. Rubin. "New Estimates of the Determinants of Urban Crime." Annals of Regional Science 9 (March 1975): 68-76.

Kmenta, Jan. Elements of Econometrics. New York: The MacMillan Company, 1971.

McPheters, Lee R. and William B. Stronge. "Law Enforcement Expenditures and Urban Crime." National Tax Journal 47 (December 1974): 633-644.

Mehay, Stephen L. "The Production of Crime Deterrence by Urban Police Departments." Working Paper No. 23, Concordia University, Montréal, 1974.

Morris, Douglas and Luther Tweeten. "The Cost of Controlling Crime: A Study in Economies of City Life." Annals of Regional Science (June 1971.): 33-49.

Orsagh, Thomas. "Crime, Sanctions and Scientific Explanation." Journal of Criminal Law and Criminology 64 (1973): 354-61.

Phillips, Llad, Harold L. Votey Jr., and Darold Maxwell. "Crime, Youth, and the Labour Market." Journal of Political Economy 80 (May/June 1972): 491-504.

Pogue, Thomas F. "Effects of Police Expenditures on Crime Rates: Some Evidence." Public Finance Quarterly 3 (Jan. 1975): 14-44.

Quebec. Commission of Enquiry into the Administration of Justice on Criminal and Penal Matters in Quebec. Crime Justice and Society. 9 vols. Quebec Official Publisher, 1969. Vol. 3, tome 1, Crime in Quebec: Trends in Quebec Criminality.

Reynolds, Morgan. "Crimes for Profit: The Economics of Theft." Ph.D. dissertation, Dept. of Economics, University of Wisconsin, 1971.

Shoup, Carl S. "Standards for Distributing a Free Governmental Service Crime Prevention." Public Finance 19 (1964): 383-392.

Sjoquist, David Lawrence. "Property Crime and Economic Behaviour: Some Empirical Results." American Economic Review 63 (June 1973): 439-46.

Streeter, Lanny and Robert Terpstra. "An Empirical Study of the Socio-Economic Determinants of Property Crimes and the Relative Impact of Law Enforcement Efforts." Paper presented to the Western Economic Association, June 1974.

Stigler, George J. "The Optimum Enforcement of Laws." Journal of Political Economy 78 (March/April 1970).

Swimmer, Eugene. "Measurement of the Effectiveness of Urban Law Enforcement-A Simultaneous Approach." Southern Economic Journal 40 (April 1974): 618-30.

Thaler, Richard. "An Econometric Analysis of Property Crime: Interaction Between the Police and Criminals." Working Paper No. 7441, Graduate School of Management, University of Rochester, 1974.

Theil, Henri. Linear Aggregation of Economic Relations. Amsterdam: North-Holland Publishing Company, 1965.

_____. Principles of Econometrics. John Wiley & Sons, Inc., 1971.

Tullock, Gordon. "The Welfare Costs of Tariffs, Monopolies and Theft." Western Economic Journal (June 1967): 224-32.

_____. The Logic of the Law. New York: Basic Books, Inc., 1971.

U.S. Department of Justice. Law Enforcement Administration, National Institute of Law Enforcement and Criminal Justice. Evaluation of Crime Control Programs, by Michael D. Maltz. Washington, D.C.: Government Printing Office, April 1972.

U.S. The President's Commission on Law Enforcement and Administration of Justice. Task Force Report: Crime and Its Impact: An Assessment. Washington, D.C.: Government Printing Office, 1967.