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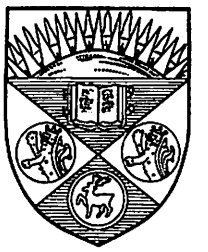

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1. Introduction

In a recent study, Avio and Clark (1976) estimate supply functions for property offenses in Canada. The results of the study differ substantially from previous research in the U.S. and the U.K. (e.g., Ehrlich, 1973; Sjoquist, 1973; Carr-Hill and Stern, 1973). First, in the Canadian study, the probability of conviction (conditional upon arrest) is found to have substantial negative impact upon the level of crime for most crime categories. Virtually all previous studies ignored this variable.[1] Second, most previous studies (e.g., Sjoquist, 1973; Carr-Hill and Stern, 1973; Greenwood and Wadycki, 1973) did not distinguish between categories of property crime. The Avio and Clark study demonstrates that such an approach may lead to erroneous policies, in that the elasticities of the dependent variables show considerable variation across crime categories. The third major difference is that whereas the U.S. and U.K. studies generally find that increases in sentence length reduce the level of property crime, no such evidence could be found for the Canadian study. The importance of this latter result cannot be overstated. If indeed, the data used to measure sentence length is an accurate reflection of the expectations of prospective offenders if apprehended and convicted (so that the coefficient of the variable indicates the true deterrent effect), and no such effect is found to exist, then public policy towards incarceration may be seriously in error.

One difficulty with the earlier Canadian study is that data exigencies required that time-series and cross-section data be pooled. Observations

consisted of Canadian provincial totals[2] for the years 1970, 1971 and 1972. In some cases, socio-economic characteristics were available for 1971 only. The present study utilizes a superior data base. Statistics Canada provided the authors with unpublished police and judicial statistics by census division areas in Ontario for 1971. Census data are used for all other variables. The purpose of the present study, then, is to resubmit the economic model of crime to empirical test using a superior data base, and to test some new hypotheses concerning the deterrent effect of incarceration. The results indicate that the data generally support the economic model of crime, but that, as with the previous Canadian study, no evidence is found to support the existence of a deterrent effect of incarceration.

Section 2 briefly summarizes the economic model of crime. Section 3 discusses the data used to represent the variables suggested by theory. The general empirical results are displayed and discussed in section 4; alternative formulations of the sentence length hypotheses are presented in section 5.

2. Supply of Offense Functions

As reported in the earlier study (Avio and Clark, 1976) and elsewhere (e.g., Ehrlich, 1973), an aggregate[3] supply of offenses function may be specified for each category of property crime. Briefly, the supply of offenses depends upon the various risks and costs (including opportunity cost) associated with criminal activity, the expected gains from crime, and various demographic and sociological factors. The supply function for crime type i may be written in log-linear form:

$$(1) \qquad \ln O_i = \ln a + \sum_{j=1}^{n} \alpha_j \ln p_j + \sum_{j=1}^{n} \beta_j \ln q_j + \sum_{j=1}^{n} \delta_j \ln S_j + \sum_{j=1}^{n} \gamma_j \ln G_{Cj} + \varepsilon \ln G_L + \sum_{w=1}^{m} \mu_w \ln X_w^i \quad (i=1,\ldots,n) .$$

The variables are defined

O_i = the number of offenses of crime category i, per 1,000 population;

P_j = the mean subjective probability of apprehension by the police for crime category j;

q_j = the mean subjective probability of conviction for crime category j, given that the offender is apprehended;

S_j = the mean expected sentence length for crime category j, given that the offender is convicted;

G_{Cj} = the mean expected gains from engaging in crime j;

G_L = the mean expected gains from engaging in legitimate behavior (i.e., the opportunity costs of crime);

X^i = vector of variables which affect the psychic income or "tastes" for crime i.

Insofar as the dependent variables in equation (1) affect the willingness of victims to report crime, the estimated elasticities in the equation are composed of two separate elasticities: the "true" supply response, and the elasticities of the recording function. (The recording function relates the percentage of actual crimes which are recorded to variables which determine this percentage.) As the data necessary for estimating a recording function do not exist, it is impossible to disentangle the two elasticities associated with each variable by direct estimation. If, however, a variable is excluded from the recording function, then the estimated elasticity will be the "true" elasticity.[4]

The predicted signs of certain of the variables are unambiguous: α_i,

β_i and δ_i are predicted to be negative (as the expected cost of a particular category of crime rises, fewer crimes of that type will be committed). The sign of γ_i is predicted to be positive (if the gains from criminal activity increase, then crime rates will increase) and ε is predicted to be negative (as the opportunity cost of crime increases, fewer crimes will be committed). Concerning the cross elasticities, no a priori statements can be made, because property crimes may be substitutes or complements. For example, an increase in the probability of apprehension for break and enter may induce an increase in theft as offenders switch crimes, or it may induce a decrease in theft, as prospective offenders move out of criminal activities completely, and into legitimate endeavours.

The causality in equation (1) is not necessarily undirectional. The main source of simultaneous equations bias would appear to be the effect of an increase in the offense rate on resources devoted to the criminal justice system, and on the allocation of police resources between crimes. In turn, these changes should affect the probabilities of apprehension.[5] Therefore, consistent estimates are obtained by specifying two additional sets of equations: a set of equations explaining the clearance rate by police, and an equation explaining public expenditures on crime (Ehrlich, 1973; Avio and Clark, 1976). These equations are relevant for present purposes in that they determine the instrumental variables used in estimating the supply equations.

3. Data

Data used to represent expected clearance rates (P_j) and expected (conditional) conviction rates (Q_j) are frequently ratios reported by the police and by the courts. The clearance rate variable is the ratio of offenses

cleared by charge (and otherwise, e.g., by death of suspect) to the total number of offenses recorded. Conviction rates refer to the number of convictions divided by the number of charges.

The method of measuring sentence length differs considerably from other studies, which have utilized a weighted average of sentences of inmates released in the current period. Briefly, the statistic used here is a weighted average of sentences handed down by the courts, corrected for remission and parole possibilities (S_j).[6] This latter statistic is superior to the commonly used statistic on three grounds. First, the entire distribution of sentences may change over time. This will impart a bias to the commonly used measure since the experience of an offender sentenced, say, five years ago, would then be irrelevant to someone contemplating the commission of an offense today. A prospective offender should be concerned only with the current distribution of sentences as an indicator of his current prospects.[7] Second, the commonly used measure is biased if the number of offenders sentenced in each period changes. This is because the weights assigned to each sentence length are affected by the number sentenced in each period (Avio and Clark, 1976, Appendix D). Thus, even if there is no change in the distribution of sentences, the proxy used to measure expected sentence lengths would change. Third, the commonly used statistic may be measuring the "training" effects of having served a sentence, rather than the pure deterrent effect based on the expected cost of punishment. A variable based on the experience of offenders released in the current period should be particularly suspect in this regard.

Data used to measure the O, P, Q and S variables were obtained from Statistics Canada, which assigned data from police reporting units and courts to census division areas in Ontario.[8] It appears that the geographical

correspondence between census division areas and judicial districts is quite close, whereas that between census division areas and police reporting units is less exact. In those cases where several police reporting units were located within a single census division area, the data were combined by Statistics Canada. To protect the confidentiality of police data within those census division areas which include only one police reporting unit, some census division areas were amalgamated by Statistics Canada.

The expected gains from legitimate activities (the opportunity cost of crime) are measured in this paper by total (male and female) unemployment rates. Increases in unemployment rates reduce the opportunity cost of crime in a probabilistic sense, and hence, should act to increase crime rates.

The expected gains from criminal activities depend primarily upon the size of the "victim stock". Unfortunately, data on the value of property available as booty for criminals do not exist.[9] However, rental rates for housing services may be highly correlated with the victim stock; high rent districts would likely encompass larger amounts of property available for illegal transfer than would low rent districts. This reasoning provides the basis for using differences in average rental rates for housing services as a proxy for differences in victim stocks. If differential rents merely represent differences in housing markets, and are not indicative of differences in the size of the victim stock, then the coefficient of the rent variable should not prove to be positive, as predicted by theory. A more serious problem is the confounding of the victim stock variable with the opportunity cost of crime variable. A high opportunity cost of crime (high income from legitimate endeavours) would likely be consistent with a large victim stock. Thus it may be difficult to disentangle the independent effects of the two variables. The degree to which this collinearity invalidates the empirical

results is a statistical matter, and must be evaluated in terms of the results. Several alternative proxies for the victim stock were employed at an early stage of the estimation, but all proved marginally inferior to the rent variable.[10]

An implicit assumption of the model is that each census division area is a self-contained unit with respect to crime. This assumption presents theoretical and statistical problems. First, offenders may reside in one area but commit crimes in another due to "pull" effects. For example, a neighbouring area might have a relatively large victim stock, and thus "pull" offenders who reside in other areas. In an attempt to test for the existence of pull effects, it was assumed that the independent variable exerting the strongest effect on the crime rate would also exert the strongest pull effects. Thus the clearance rate of neighbouring census division areas were used as explanatory variables in the supply of offenses equations. The hypothesis is that as the clearance rate increases in neighbouring areas, more offenses will be committed in the "home" census division area, as offenders seek a less risky environment to commit crime. For all categories of property crime, the test results indicate the insignificance of the variable, thus lending some credence to the assumption that census division units are self-contained markets for crime.

A second difficulty with using census division areas as data observations is empirical, and arises because of the reporting procedures of the Ontario Provincial Police (O.P.P.). The O.P.P. report through seventeen regional headquarters, and not on a census division basis. Thus it is possible that a crime might be committed in one census division area, but be reported in another. In an attempt to account for this phenomenon, a dummy value of unity is assigned to those census division areas which contain an O.P.P.

headquarters, and where the location of the headquarters is near the border of an adjoining census division area.[11]

4. Empirical Results

The basic set of supply equations are reported in Table 1.[12] The property crimes investigated are robbery, theft, break and enter, and fraud.[13] The method of estimation is weighted two stage least squares, with the clearance rate an endogenous variable. The standard parametric F-test suggested by Goldfeld and Quandt (1965) indicates a significant inverse relationship between population size and residuals. The corrected data (using the square root of population as the correction factor) yield homoscedastic errors, according to the same test.

Instrumental variables used are the rate of offenses against the person, clearance rates for offenses against the person, population per square mile, average income, motor vehicle registrations, and the exogenous variables in the supply equations. Average income is taken as a measure of the ability to pay for police and hence is included in the demand for police protection equation. The other instrumental variables are arguments in the police production functions (Avio and Clark, 1976).

In general, the empirical results of Table 1 confirm that risks, opportunity costs and expectations of criminal gain influence property crime in Ontario in the predicted manner. The significance of the clearance rate variable indicates that through the police, society exerts substantial control over the number of reported property offenses. The lone exception appears to be the fraud category. However, the apparent insensitivity of fraud to police activity is explained by examining the relationship between crimes. Prospective perpetrators of fraud may feel that the fraud clearance rate as recorded

TABLE 1: Weighted Two Stage Least Squares Regression Estimates of the Offense Equations (clearance rate exogenous)

Equation	Intercept	ln $\hat{P}$	ln Q	ln S	ln UR	ln RENT	ln AGE	ln IND	DOPP	R^2
					Robbery					
1.	-10.586 (-3.501)	-1.462 (-3.674)	-0.367 (-0.784)	-0.043 (-0.862)	0.863 (1.518)	1.280 (2.125)			0.624 (2.854)	.496
2.	-15.433 (-1.979)	-1.349 (-2.946)	-0.335 (-0.704)	-0.047 (-0.924)	0.844 (1.465)	1.542 (2.113)	1.683 (0.676)		0.669 (2.9)	.508
3.	-9.781 (-2.715)	-1.405 (-3.448)	-0.382 (-0.798)	-0.038 (-0.725)	0.99 (1.499)	1.057 (1.265)		-0.073 (-0.44)	0.625 (2.805)	.500
4.	-15.332 (-1.837)	-1.275 (-2.741)	-0.343 (-0.704)	-0.043 (-0.804)	0.95 (1.412)	1.383 (1.432)	1.891 (0.745)	-0.063 (-0.376)	0.675 (2.865)	.511
					Break and Enter					
1.	0.438 (0.255)	-1.105 (-4.952)	-0.376 (-0.545)	-0.067 (-0.337)	1.185 (3.312)	-0.535 (-1.25)			0.936 (5.757)	.930
2.	-8.206 (-2.251)	-0.996 (-4.812)	-0.817 (-1.272)	-0.194 (-1.051)	1.014 (3.066)	-0.167 (-0.405)	3.362 (2.618)		0.974 (6.626)	.945
3.	-0.501 (-0.286)	-1.189 (-5.487)	-0.679 (-0.986)	-0.044 (-0.227)	0.935 (2.484)	-0.252 (-0.565)		0.163 (1.896)	0.968 (6.114)	.935
4.	-8.586 (-2.416)	-1.072 (-5.337)	-1.062 (-1.67)	-0.167 (-0.962)	0.787 (2.289)	0.078 (0.185)	3.174 (2.535)	0.150 (1.94)	0.998 (6.992)	.949
					Theft					
1.	-2.301 (-1.844)	-1.018 (-5.523)	0.574 (0.839)	0.003 (0.079)	0.691 (2.719)	0.525 (2.139)			0.485 (3.992)	.981
2.	-5.014 (-1.674)	-0.947 (-4.805)	0.577 (0.864)	-0.001 (-0.034)	0.632 (2.467)	0.644 (2.399)	1.066 (0.984)		0.504 (4.201)	.983
3.	-2.131 (-1.597)	-1.012 (-5.364)	0.587 (0.844)	0.002 (0.038)	0.739 (2.432)	0.469 (1.539)		-0.023 (-0.319)	0.486 (3.937)	.981
4.	-4.989 (-1.641)	-0.934 (-4.665)	0.591 (0.873)	-0.003 (-0.086)	0.681 (2.261)	0.588 (1.846)	1.33 (1.036)	-0.026 (-0.373)	0.506 (4.16)	.983

TABLE 1: continued

Equation	Intercept	ln $\hat{P}$	ln Q	ln S	ln UR	ln RENT	ln AGE	ln IND	DOPP	R^2
					Fraud					
1.	-3.937 (-2.228)	0.098 (0.228)	-1.068 (-1.004)	0.057 (0.495)	0.238 (0.749)	0.887 (2.308)			0.493 (3.084)	.879
2.	-9.534 (-1.884)	0.423 (0.836)	-1.497 (-1.312)	0.055 (0.474)	0.143 (0.429)	1.228 (2.529)	1.935 (1.184)		0.514 (3.135)	.878
3.	-4.175 (-2.241)	0.043 (0.100)	-1.043 (-0.972)	0.064 (0.543)	0.133 (0.351)	0.981 (2.239)		0.05 (0.535)	0.491 (3.045)	.881
4.	-9.244 (-1.808)	0.368 (0.714)	-1.452 (-1.262)	0.060 (0.502)	0.086 (0.221)	1.261 (2.448)	1.782 (1.063)	0.031 (0.316)	0.511 (3.080)	.88

t statistics are in parentheses. The robbery equations have 29 observations, whereas all other property crime equations have 39.

Definitions of variables:

P = clearance rate
Q = conviction rate, conditional upon arrest
S = expected sentence length
UR = total (both sexes) unemployment rate
RENT = average monthly rental
AGE = percent of the population that is male and between the ages 15-24
IND = percent of the population that is North American Indian
DOPP = dummy variable for Ontario Provincial Police Regional headquarters

is an unreliable indicator of the true rate of identification of fraud offenders. Fraud cases may be handled informally, outside the criminal justice system: an employee who embezzles is dismissed, the utterer of a forged cheque may not be prosecuted if the funds are made good. Thus prospective fraud offenders may look to clearance rates of other property offenses as a more reliable estimate of their own chances. In an attempt to test this hypothesis and the more general hypothesis that crime categories may be substitutes or complements, clearance rates for various property crimes were included sequentially in each supply equation. The only significant relationship found between property crimes is in the fraud equations; clearance rates for theft and break and enter have a negative significant impact upon the fraud rate. Thus it would appear that all categories of recorded property crime are sensitive to police success in apprehending offenders. Furthermore, the own clearance rate elasticities (see Table 1) are larger than unity in absolute value, indicating a relatively strong response of offenders to changes in clearance rates.

The conditional conviction rate variable is insignificant for all equations, and has the wrong sign in the theft equations. One would predict that this variable would display a smaller (absolute value) coefficient than the clearance rate, because apprehension can lead to more unfavourable final outcomes (one might be convicted of a lesser crime, for example) than conviction.[14] Nevertheless, one would still expect the coefficient to be negative and significant. The puzzlement is increased by noting that this variable was strongly significant in the previous Canadian study (Avio and Clark, 1976).

The opportunity cost of crime (as measured by the unemployment rate, UR) is significant with the predicted positive sign in the break and enter and

theft equations, and approaches significance in the robbery equation. The failure of this variable in the fraud equations is not surprising, as the rate of unemployment is probably not a good proxy for the opportunity cost of crime for at least one category of prospective fraud offenders -- white collar workers.

The variable used as a proxy for the size of the victim stock (RENT) is significant and positive (as predicted) in at least half of the robbery, theft and fraud equations. The variable is not significant in the break and enter equations. This result is puzzling, since one would expect the victim stock to be at least as important in the criminal decision to commit this crime, relative to other property crimes. In comparing the RENT and UR variables across crimes, the UR variable is generally larger and more significant in the break and enter equations, whereas the RENT variable performs better for the other property crimes. Thus one possibility is that the collinearity between RENT and UR acts to diminish the significance of the RENT variable in the break and enter equations.

Two demographic characteristics of the population were investigated for their influence on crime rates (equations 2, 3 and 4). The percentage of the total population that is aged fifteen to twenty-four and male (AGE) is found to be insignificant for all crimes except break and enter, where the coefficient is positive. These results appear to more closely substantiate the conventional wisdom than the results reported for all of Canada in the earlier study, which indicated insignificance in the break and enter and theft equations, and <u>negative</u> significance for robbery and fraud. The percentage of the population that is North American Indian (IND) approaches significance[15] only in the break and enter equations. In the earlier Canadian study this variable was generally significant for all property crime categories except

fraud when unemployment and participation rates (excluding those of reservation Indians) were included in the equations. The insignificance of the Indian variable in the Ontario study and the (general) significance of the variable in the all-Canada study suggests that in the former study the variable may have been accounting for some other systematic relationship. Since North American Indians compose a relatively larger proportion of the population in the Western provinces, it may be that the variable was measuring factors which account for differential crime rates between the Western and Eastern provinces, outside of those variables explicitly accounted for in the equations and the effects of differential proportions of North American Indians in the population.

A commonly voiced sociological argument is that "attachment to neighbourhood" is important in determining the level of property crime. In economic terminology, strong attachment to neighbours and community increases the costs of crime if one is apprehended and convicted, because of the social (and perhaps economic) stigma that is placed on known offenders. In an attempt to test this hypothesis, differential levels of attachment are assumed to be measured by a "mobility" index, where the index is the percent of dwellings occupied by the current resident for less than one year. The coefficient is predicted to be positive for all property crimes. The results (not reported in Table 1) indicate that break and enter is the only offense which yields a positive significant coefficient for the mobility variable. That break and enter yields a different result from other crimes suggests that the common rationale does not apply in general, and a specific explanation must be sought for the break and enter results. One possibility is that residents of more settled communities spend a relatively larger proportion of their leisure time in home-oriented activities, and hence, are implicitly devoting greater

resources (time) to self-protection. This would be expected to have a greater deterrent effect on break and enter offenses than other property crimes, as the former offenses generally occur within the home, and typically when the residents are away.[16]

5. The Effect of Punishment

As noted in the earlier Canadian study and confirmed in the above equations, the expected length of sentence does not appear to significantly reduce the level of property crime. The importance of this result suggests the investigation of alternative hypotheses, the results of which are reported in Table 2. One possibility is that expected sentence length does act as a deterrent, but the coefficient is insignificant due to a simultaneity problem arising from the courts issuing more severe sentences when the crime rate increases. If this hypothesis is correct, then sentence length should be treated as an endogenous variable in the supply equations. Equations (2) of Table 2 give very tentative support for the hypothesis (especially for fraud and theft) but the coefficients are not significant. Perhaps the best interpretation is that there is some slight evidence that courts do respond to higher crime rates by handing down somewhat longer sentences in certain instances, but the statistical corrections for this behavior do not lead to results which indicate the presence of an independent deterrent effect for longer expected sentences.

One commonly heard suggestion for change in the sentence procedure is that the courts not be allowed discretion in setting sentence lengths. In these circumstances, a prospective offender would know in advance his sentence if convicted. Those who argue in favour of this sentencing scheme feel that the certainty of sentence length (given conviction) acts as a

TABLE 2: Weighted Two Stage Least Squares Estimates Sentence Length Hypotheses

Equation	Intercept	ln $\hat{P}$	ln Q	ln S	ln $\hat{S}$	ln VARS	ln JL	ln SJL	ln UR	ln RENT	DOPP	R^2
					Robbery							
1.	-10.586 (-3.501)	-1.462 (-3.674)	-0.367 (-0.784)	-0.043 (-0.862)					0.863 (1.518)	1.280 (2.125)	0.624 (2.865)	.496
2.	-11.256 (-3.186)	-1.394 (-3.161)	-0.339 (-0.706)		-0.08 (-0.731)				0.861 (1.494)	1.456 (1.902)	0.594 (2.523)	.483
3.	-8.603 (-2.545)	-1.342 (-3.323)	-0.443 (-0.951)	-0.053 (-1.061)		0.027 (1.251)			0.913 (1.622)	0.849 (1.235)	0.675 (3.073)	.531
4.	-9.934 (-3.453)	-1.444 (-3.65)	-0.382 (-0.821)				-0.18 (-0.984)		0.879 (1.552)	1.286 (2.175)	0.606 (2.752)	.501
5.	-7.84 (-1.876)	-1.441 (-3.599)	-0.441 (-0.922)				-0.7 (-0.912)	0.144 (0.698)	0.964 (1.646)	1.219 (2.014)	0.567 (2.463)	.512
					Break and Enter							
1.	0.438 (0.255)	-1.105 (-4.952)	-0.376 (-0.545)	-0.067 (-0.337)					1.185 (3.312)	-0.535 (-1.25)	0.936 (5.757)	.930
2.	-0.662 (-0.282)	-1.128 (-4.747)	-0.242 (-0.323)		-0.426 (-0.802)				1.129 (2.930)	-0.203 (-0.318)	0.962 (5.488)	.922
3.	0.478 (0.272)	-1.093 (-4.835)	-0.376 (-0.536)	-0.121 (-0.341)		0.035 (0.182)			1.169 (3.198)	-0.545 (-1.232)	0.930 (5.643)	.930
4.	0.145 (0.078)	-1.147 (-4.984)	-0.382 (-0.556)				0.137 (0.539)		1.258 (3.432)	-0.644 (-1.674)	0.962 (5.684)	.929
5.	-0.143 (-0.075)	-1.155 (-5.011)	-0.194 (-0.268)				0.096 (0.369)	-0.236 (-0.88)	1.257 (3.415)	-0.460 (-1.049)	0.991 (5.722)	.931

TABLE 2: continued

Equation	Intercept	ln $\hat{P}$	ln Q	ln S	ln $\hat{S}$	ln VARS	ln JL	ln SJL	ln UR	ln RENT	DOPP	R^2
					Theft							
1.	-2.301 (-1.844)	-1.018 (-5.523)	0.574 (0.839)	0.003 (0.079)					0.691 (2.719)	0.525 (2.139)	0.485 (3.992)	.981
2.	-2.73 (-1.834)	-0.984 (-4.545)	0.734 (0.91)		-0.139 (-1.239)				0.846 (2.671)	0.545 (1.898)	0.506 (3.547)	.974
3.	-2.156 (-1.690)	-1.016 (-5.479)	0.622 (0.899)	-0.061 (-0.611)		0.058 (0.703)			0.668 (2.585)	0.481 (1.881)	0.491 (4.003)	.981
4.	-2.157 (-1.746)	-0.992 (-5.526)	0.668 (0.956)				-0.05 (-0.536)		0.696 (2.821)	0.533 (2.195)	0.488 (4.062)	.982
5.	-1.941 (-1.557)	-0.958 (-5.368)	0.737 (1.049)				-0.083 (-0.819)	0.034 (0.807)	0.65 (2.595)	0.532 (2.199)	0.483 (4.039)	.982
					Fraud							
1.	-3.937 (-2.228)	0.098 (0.228)	-1.068 (-1.004)	0.057 (0.495)					0.238 (0.749)	0.887 (2.308)	0.493 (3.084)	.879
2.	-4.472 (-1.989)	-0.429 (-0.51)	-0.045 (-0.024)		-0.396 (-0.675)				0.39 (0.906)	0.947 (2.003)	0.675 (2.247)	.822
3.	-3.246 (-1.604)	0.041 (0.093)	-0.956 (-0.884)	-0.132 (-0.489)		0.107 (0.72)			0.188 (0.577)	0.725 (1.616)	0.492 (3.069)	.882
4.	-3.576 (-1.881)	0.018 (0.044)	-0.874 (-0.850)				-0.132 (-0.596)		0.209 (0.648)	0.929 (2.407)	0.512 (3.372)	.880
5.	-3.651 (-1.896)	0.14 (0.323)	-1.080 (-1.009)				-0.119 (-0.53)	0.114 (0.858)	0.136 (0.403)	0.943 (2.413)	0.463 (2.829)	.882

deterrent. The economic rationale for this argument is based upon the risk behavior of offenders. If offenders are risk preferers[17] (positive marginal utility of income) then a reduction in the variance of sentence length acts to reduce the expected utility of crime. This hypothesis is consistent with a positive relationship between the variability of sentences and the crime rate. In equations (3) of Table 2, VARS is the variance of the expected sentence length variable. In all cases, the signs of the coefficients are consistent with the hypothesis, although again not significant. Inclusion of VARS also yields some support for the predicted effect of expected sentence length (S), especially in the reversal of perverse signs for S in theft and fraud.

A further possibility is that offenders do not perceive different costs in sentences of different lengths; ex ante they are concerned only with the conditional probability of being sentenced to jails. Such an hypothesis is consistent with high rates of time preference by prospective offenders, as they discount long sentences. In equations (4) and (5) of Table 2, JL is the percent of convicted offenders sentenced to jail, and SJL is the expected sentence of those sent to jail. The sign of the JL coefficient conforms to the hypothesis in three of the four crimes, whereas the sign of the SJL is perverse for the same number of crimes. Statistical significance cannot be claimed for either of the variables.

To summarize this investigation of the deterrent effects of incarceration, the evidence for the existence of such an effect is extremely weak. A significant inverse relationship between incarceration prospects and crime rates is not found for any of the variables examined. This result is consistent with the earlier Canadian study (Avio and Clark, 1976), but stands in sharp contrast to studies conducted by economists in the U.S. and the U.K.,

regardless of the variable used to measure incarceration prospects (i.e., percent of convicted offenders who are incarcerated or expected sentence length). One possible reason for the discrepancy when expected sentence lengths is taken as the measure of incarceration prospects, is that the two Canadian studies based their estimates of expected sentence lengths on the then-current judicial practices, whereas other studies attempting to measure the same variable based their estimates on the experience of offenders released in the current period. Earlier in this paper we have noted the possibility of bias in using the latter method. However, this does not explain the differences in results when the (conditional) probability of incarceration is used as a proxy for incarceration prospects (Carr-Hill and Stern, 1973). One possibility is simply that the conditional probability of incarceration is not the appropriate measure of incarceration prospects, so that the results are spurious. An alternative explanation is that Canadian prospective offenders respond differently than prospective offenders in other countries -- increases in sentences do not provide a deterrent effect to Canadian offenders. If this hypothesis is accepted, one must explain why Canadian offenders are deterred by the threat of apprehension. One possibility is that offenders assign high costs to being associated by the police with a crime, regardless of whether one is subsequently convicted and incarcerated. This explanation seems particularly relevant for those prospective offenders who do not have prior police records, and would suffer relatively strong social (and perhaps economic) discrimination if charged with an offense, regardless of the outcome. A second possibility is that offenders do associate relatively high costs to conviction and incarceration, but because of their (hypothesized) relatively high rates of time preference, these costs are substantially discounted. This hypothesis is consistent with the view of offenders as individuals who

seek "immediate gratification." This suggests that swiftness of trial and sentencing may be an extremely important factor in general deterrence. Crowded courtroom dockets and repeated delays in trial proceedings may reduce substantially the impact of conviction and sentencing. If this is in fact the case, implications may be drawn about the optimal allocation of resources among branches of the criminal justice system. If society deems the deterrent effect a necessary by-product of the conviction and sentencing of offenders, then resources should be provided to the judicial system to ensure that this deterrent effect is operational. However, an explicit test of the relationship between deterrence and swiftness of trial and sentencing is yet to be made.

FOOTNOTES

*Professor Avio is at the University of Victoria and Professor Clark at the Treasury Board Secretariat, on leave from the University of Western Ontario. The research was funded by an allocation from the Academic Development Fund, University of Western Ontario.

[1]An exception is Sjoquist (1973) who found the conditional probability of conviction to be insignificant in the only equation reported which also included the apprehension (or "clearance") rate as a risk variable.

[2]Alberta and Quebec were excluded because judicial data were not available.

[3]For a discussion of the aggregation problem, see Avio and Clark (1976).

[4]For example, suppose that the length of sentences handed down to offenders does not affect the willingness of victims to report crime. Then the δ_j in equation (1) become measures of the true supply response of offenses to changes in sentence lengths. For further discussion, the reader is referred to Carr-Hill and Stern (1973) and Avio and Clark (1976). The latter study suggests a method for determining a range of the true elasticities, subject to restrictions on the recording function.

[5]It may also be that judges respond to increases in offenses by giving more severe sentences. This hypothesis is discussed in section 5.

[6]The reader is referred to Avio and Clark (1976, Appendix D) for the actual formula used and an explanation of the weighting procedure.

[7]It may be, however, that a prospective offender utilizes information on offenders who are released in the current period, regardless of the bias that this procedure implies. He would likely do so if information on sentences given to current period offenders is costly to obtain. With the reporting practices of newspapers it would be difficult to argue that the cost of obtaining the relevant information is prohibitive.

[8]Data on offense rates (O) and clearance rates (P) are reported by the police, and are comparable to data found in Crime Statistics, Statistics Canada, catalogue 85-205. Data on conviction rates (Q) and expected sentence lengths (S) are reported by the courts and are comparable to data found in Table 11, Statistics of Criminal and Other Offenses, Statistics Canada, catalogue 85-201 (Q) and Tables 6A-6B of the same catalogue (S). The factors used to correct for the possibilities of parole and earned remission are the 1971 national averages, as discussed in Avio and Clark (1976, Appendix D).

[9]In Avio and Clark (1976), the number of homes with record players was used as a proxy measures for the victim stock.

[10]Alternative measures were televisions per square mile, number of owned homes per square mile and population per square mile.

[11]The observations which were assigned unit values of the dummy variables are Kent, Middlesex, Halton, Niagara, Wellington, Simcoe, Peterborough, Hastings - Prince Edward, Lanark, Dundas and Stormont.

[12]Sample size is 39 for fraud, theft and break and enter, and 29 for robbery. The 1971 census lists fifty-four census division areas in Ontario. The amalgamation by Statistics Canada, occasioned in part by police

confidentiality requirements and in part by the reporting of judicial data, reduced the sample. Two observations were dropped because of obvious data discrepancies (confirmed by Statistics Canada), leaving a total of thirty-nine observations. However, there were no robberies committed in ten census division areas. These observations had to be dropped from the robbery sample because clearance and conviction rates are undefined.

[13]Definitions of crime categories and problems involved in integrating judicial and police statistics are discussed in (Avio and Clark, 1976). The "theft" results for this study are consistent with the definitions used for "theft B" of the earlier study. Empirical results for the two categories of theft were virtually indistinguishable.

[14]Furthermore, one would expect an even smaller coefficient associated with the sentence length variable. For a proof of the proposition that "... the more general the event leading to the undesirable consequences of crime, the greater the deterrent effect associated with its probability ..." see Ehrlich (1975, p. 401).

[15]The critical value of the t-statistic at the five percent level is 2.042 (two-tailed test, Student's t-distribution).

[16]A second sociological hypothesis is that formal education tends to instill respect for the law. To test the hypothesis, the percent of non-attenders who did not attain a grade nine education was used as an explanatory variable, with a predicted positive sign for the coefficient. The variable is positive and significant for theft, and displays an elasticity greater than unity for theft, break and enter and robbery. The interpretation must

be made with some care however, as labour market opportunities likely depend upon educational achievement. In fact, the unemployment rate becomes insignificant in the theft equation when the education variable is included; the unemployment coefficients and t ratios are stable for other crime categories.

[17]One implication of the Becker model is that offenders are, on balance, risk preferers (Becker, 1968, p. 178). The necessity of this conclusion is disputed by Avio (1972, pp. 23-26) and by Brown and Reynolds (1973).

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