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**THE ECONOMICS OF CRIME PREVENTION POLICY -
WITH PARTICULAR REFERENCE TO VARIOUS CRIME
CATEGORIES IN SOUTH AFRICA**

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ABSTRACT**THE ECONOMICS OF CRIME PREVENTION POLICY - WITH PARTICULAR
REFERENCE TO VARIOUS CRIME CATEGORIES IN SOUTH AFRICA**

Author: Kay Vyvyan Brown (July 2001)

The criminal justice system is the instrument used by Government to control crime because it is generally believed that this is more efficient in preventing crime than other types of public expenditure. In this thesis the relative importance of law enforcement, economic and socio-economic variables in determining South African crime is assessed. An interdisciplinary theory of crime is developed, based on the economic model but including additional variables from both sociology and political science. Data was obtained from the Human Science Research Council, Central Statistical Service (now Statistics South Africa) and departments comprising the criminal justice system. Two stage least squares estimation procedures are adopted to estimate the total, property and violent crime rate equations for ninety magisterial districts in 1994, the probability of prosecution being an endogenous variable. As modelling reveals that all categories of variables significantly influence the total and property crime rate, the central hypothesis in this study is verified. ~~More expenditure exclusively on the criminal justice system is not the most effective policy.~~ other types of public expenditure must also be used in crime prevention. Those which would significantly reduce crime concern improvements in education and the well-being in female headed households and the reduction of poverty and possibly unemployment. Law enforcement variables are not the only influence on crime but they have an inherent function within a society based on the rule of law. Therefore, the study moves on to a production function analysis of policing relating to total, property and violent crime in South African provinces in the quarters of 1997 to 1999. Ordinary least squares estimation procedures are adopted to estimate the log-linear fixed effects models. Analysis indicates that policing output increases with expenditure on vehicles and average years of officer experience. However, increases in personnel do not increase output. Therefore, the secondary hypothesis in this study is verified. More expenditure on South African Police Service personnel is not most effective for crime prevention. The findings highlight that the productivity of personnel can be improved by expenditure aimed at enhancing competency.

CHAPTER ONE

ADDRESSING THE CRIME PROBLEM IN SOUTH AFRICA

1.1 INTRODUCTION

Crime is a serious problem in South Africa, yet until very recently, no aggregate level empirical research had focused on identifying the factors that are significant determinants of crime. Traditionally theorists have argued that expenditure on the criminal justice system will always be more efficient in preventing crime than other types of public expenditure. Worldwide the evidence seems to indicate that this is questionable, expenditure on the criminal justice system has been increasing and yet crime continues to increase. Even though the focus has been on the criminal justice system, the efficiency of the various resources employed within the system in South Africa has never been analyzed empirically in order to ascertain their contribution to crime prevention.

In this chapter the negative impact of crime on South Africa will be discussed at length, as will the crime prevention operations of the South African criminal justice system. Given this background, the aims of this study will be spelled out. Then the methodology to be used will be discussed and the hypotheses of the study will be formulated. The available South African research will then be reviewed in order to provide some insight regarding how the crime problem has been addressed. Finally, the justification for considering only property and violent crimes as separate subcategories in this study will be discussed.

In Chapter Two an interdisciplinary framework of the determinants of crime will be derived. Variables from both sociology and political science will be included as possible determinants. The data available in South Africa for conducting empirical research of this nature will be considered in Chapter Three and preliminary analysis will examine the correlation between explanatory variables and the crime rates considered. In Chapter Four the relative importance of, not only the various law enforcement variables, but also economic and socio-economic variables in determining crime in South Africa will be assessed using formal empirical models. This has direct relevance pertaining to the types of public expenditure to be considered in crime prevention and the relative importance of their application, which will

also be discussed in Chapter Four. Given its statutory function in addressing crime, the criminal justice system will be the focus of Chapter Five. A production function analysis will be performed, in order to empirically test the relative importance of the various resource inputs in determining system output. Ultimately, the effectiveness of achieving a given reduction in crime by manipulating different departmental resource inputs will be ascertained. The conclusions of this study and further recommendations will be presented in Chapter Six.

1.2 THE CRIME PROBLEM IN SOUTH AFRICA

In 1994 Glanz (1994:xiii) stated that '[f]ew people would deny that crime has reached critical proportions in South Africa'. Then in 1996 a Nedcor report (1996:8) claimed - 'the overall perception seems to be that we are losing the battle against crime'. The information in Table 1.1 below, calculated by the author from the operational statistics of the South African Police Service, shows that the situation had not improved by 1999. Unfortunately, a moratorium placed on the release of South African crime statistics precludes an assessment of the current position. Although the available statistics have been used in this study, it should be noted that '[i]n announcing the ban, the government blamed flawed statistics that required improvement' (Shaw & Gastrow 2001:237). This study will spell out the limitations of the data in detail throughout the thesis.

The overall crime¹ rate per 100 000 citizens was 5 580 in 1999, 24 percent higher than the 1994 rate of 4 496. The only year in which the crime rate decreased was 1997. In 1999 alone it increased by 5 percent. This information, however, does not reflect the level of crime in South Africa completely. The crime rate is underestimated as a result of under reporting and under recording of crimes. This is discussed in detail in Section 3.2 on pages 87 and 88. Although the analysis of trends using incomplete data can be quite accurate, it should be noted that this is only the case if it can be assumed that the errors in the data are consistent.

According to the Nedcor report 'there is the historical dynamic, manifested in a long buildup of rates of crime and violence, going back to at least the beginning of the 1980s' (1996:70).

The extent of growth in the more serious crimes in South Africa over time is reflected in a South Africa Foundation report (1996:30). A comparison of the 1975 and 1994 crime rates for: murder, rape, motor vehicle theft and robbery indicated that all of the crimes displayed an upward long-term trend. Motor vehicle theft and robbery rates more than doubled. From Table 1.1 it is clear that in the five years since 1994, an upward trend is still evident for rape and robbery. The rape rate increased by 9 percent and the robbery rate by 30 percent. The robbery rate continues to be disproportionately high but it is even more disconcerting that approximately a third of the increase in robbery occurred in 1999. On the other hand, the murder rate has fallen consistently over the five years and is 20 percent lower than the 1994 rate. Motor vehicle theft rates have also decreased substantially, by 11 percent over time. They, however, appear to be fluctuating considerably of late and the 1999 rate is higher than the 1996 rate. Other serious crimes which are considered in Table 1.1 are: burglary, serious assault (with the intent to inflict grievous bodily harm), fraud and attempted murder. The burglary rate has increased by 8 percent in the last five years and the serious assault rate by 10 percent. Assault rates decreased in 1997 and 1998 but increased by 7 percent in 1999. The fraud rate decreased by 3 percent in 1995 and has remained relatively stable since. The attempted murder rate has also fallen, by 5 percent since 1994 but appears to be fluctuating quite considerably. The only crime for which a reversal in the historical upward trend appears to be evident, is murder.

Table 1.1: Incidence of Reported Crime per 100 000 Citizens

	1994	1995	1996	1997	1998	1999	Change (5 years)	Change (1 year)
Population	38 630 500	39 477 000	40 342 200	41 226 600	42 130 400	43 054 306	11%	2%
All Crime	4 496	4 886	5 227	5 137	5 330	5 580	24%	5%
Murder	69	68	68	60	59	55	-20%	-6%
Attempted								
Murder	70	67	72	68	70	67	-5%	-5%
Rape	109	120	126	126	117	119	9%	2%
Burglary	816	826	808	801	857	879	8%	3%
Motor								
Vehicle Theft	269	255	238	229	255	240	-11%	-6%
Robbery	302	304	292	283	357	392	30%	10%
Serious								
Assault	542	558	569	568	556	596	10%	7%
Fraud	160	154	155	154	147	155	-3%	5%

Adapted from: South African Police Service data.

The South Africa Foundation (1996:30-31) also considered the actual number of serious crimes in South Africa. Nedcor statistics reveal the same trends that were reported by the South Africa Foundation.² When the number of reported crimes for the years 1988, 1992 and 1994 were compared, a more marked upward trend was revealed than in their long-term analysis of crime rates per 100 000 of the population. This was especially so for violent crimes: over the period of 1988 to 1994 the number of rapes almost doubled, the number of murders increased by 51 percent and the number of serious assault cases by 25 percent. Between 1992 and 1994 the number of attempted murders increased by 31 percent. More recent information is provided in Table 1.2 below. It is therefore possible to compare the five year period from 1994, described in the table, to the six year period ending in 1994. According to Table 1.2: the number of rapes, serious assault cases and attempted murders increased by 21 percent, 22 percent and 5 percent respectively. The number of attempted murders have varied considerably over the period, however, the 1999 level is above the 1994 level despite the decrease in number in 1999. Murder is the only crime for which the number of incidences has decreased over the period, by a substantial 11 percent. The South Africa Foundation found that property crimes also displayed significant increases. For

the period 1988 to 1994: motor vehicle theft cases increased by 64 percent, the number of robberies (aggravated and other) by 110 percent and burglary incidences (residential and business) by 51 percent.³ For the period 1994 to 1999, incidences of robbery increased but only by 45 percent and burglary only by 20 percent. The number of fraud cases increased by 8 percent. The number of motor vehicle thefts in 1999 is just slightly higher than in 1994. Although the number decreased in 1999, it is not possible to imply that further decreases are expected as the number increased drastically in the year prior to that.

Table 1.2: Incidence of Reported Crime

	1994	1995	1996	1997	1998	1999	Change (5 years)	Change (1 year)
All Crime	1 736 707	1 928 931	2 108 554	2 117 904	2 245 442	2 402 446	38%	7%
Murder	26 717	26 892	27 258	24 655	24 875	23 823	-11%	-4%
Attempted								
Murder	27 178	26 498	29 002	28 046	29 418	28 662	5%	-3%
Rape	42 251	47 386	50 829	51 995	49 280	51 249	21%	4%
Burglary	315 311	326 112	326 039	330 158	360 919	378 304	20%	5%
Motor								
Vehicle Theft	103 827	100 633	95 815	94 282	107 513	103 502	0%	-4%
Robbery	116 559	120 008	117 758	116 635	150 430	168 976	45%	12%
Serious								
Assault	209 477	220 171	229 496	234 260	234 056	256 434	22%	10%
Fraud	61 821	60 747	62 477	63 460	62 086	66 773	8%	8%

Source: South African Police Service data.

The statistics reveal that crime has been escalating at an alarming rate, the level of crime is high even by international standards (Nedcor 1996:4, South Africa Foundation 1996:30-33). Although international crime comparisons must be interpreted with caution as the definitions of crimes and reliability of data differ across countries, it is informative to assess how our crime levels compare to those in other countries. Unfortunately the most recent extensive international survey, conducted by the United Nations' office for drug control and crime prevention, only provides comparative crime rates for 1994. South Africa was not included in their study. In the table below their findings are compared to the South African rates in 1994 and 1999, shown in Table 1.1 above. The information in Table 1.1 has been

converted to crime rates per million citizens and the assault rate was recalculated to include common assault. In South Africa the crime category fraud includes embezzlement, therefore the fraud and embezzlement categories used in the United Nations study were combined.

Table 1.3: International Comparison of Crime Rates per Million Citizens

	Murder	Assault	Rape	Robbery	Burglary	Fraud
South African Crime Rate: 1994	690	10 420	1 090	3 020	8 160	1 600
1999	550	11 110	1 190	3 920	8 790	1 550
Median Rate	79	780	65	524	1 962	572
Rate of 75 percent of Countries	18-230	140-4200	15-300	40-1550	150-13300	
Rate of 90 percent of Countries	14-590	80-7700	7-780	20-2350	30-19000	
Number of Reporting Countries	62	52	63	61	53	62
Number of Countries with Higher Rate than South Africa (1994)	2	1	1	3	13	15

Adapted from: United Nations, Global Report on Crime and Justice (New York), 1999, pp 285-288 and South African Police Service data.

From the above table it is obvious that South Africa fared badly relative to other countries. In 1994 South Africa had particularly high rates of violent crime, even by comparison to countries that have a similar socio-economic status (Shaw & Gastrow 2001:245). The murder rate was the third highest amongst the countries considered and, although it has decreased substantially, in 1999 it was still above the rate of three quarters of the countries. The 1994 assault and rape rates were the second highest in the comparison and both have increased substantially since. In South Africa in 1994 the robbery rate was high relative to the overwhelming majority of countries and it has increased by 30 percent in the last five years. Property crime rates in South Africa are not as high by international standards, however, burglary and fraud rates were well above the median rate in 1994. In 1999 the burglary rate was even higher but the fraud rate had decreased. The South Africa Foundation (1996:32-33) noted that South African property crime statistics were as high as those of developed countries and by far in excess of those of developing countries.

Rising crime may be typical in countries undergoing transition as democracy tends to compound crime by weakening the overbearing controls put in place by oppressive governments, without changing the crime-inducing social environment. Even relatively affluent citizens have an incentive to participate in crime when controls are weakened (Nedcor 1996:70). 'There are two additional aggravating circumstances [in South Africa], namely the relatively free access to firearms, and the appearance of hundreds of crime syndicates, many of which are international' (South Africa Foundation 1996:29). The use of firearms has reduced the level of skill required to commit crime and means that many crimes have lethal consequences (Shaw & Gastrow 2001:246&248). In the post-apartheid environment crime syndicates could grow rapidly. Laxer border controls encouraged international syndicates to move into South Africa more aggressively (Shaw & Gastrow 2001:251). Owing to the increased organized criminal activity, the nature of crimes perpetrated has changed to some extent and they are more violent.

The Nedcor report stated in 1996 and it seems as clear today that '[i]t is abundantly evident that the benefits of the new democracy and the revival in economic fortunes are being obscured, if not undermined, by this epidemic of lawlessness' (1996:9). The credibility and perhaps even the survival of the new democracy in South Africa is being threatened by the serious and persistent crime problem. On a macro level crime influences the economy adversely and on a micro level it constitutes a direct attack on public order and safety. Crime is a universal problem which has a negative impact on the functioning and stability of society. In South Africa it is often cited as the cause of poor economic growth (Barker 1995, Johns 1994, Nedcor 1996).

One of the key principles underlying the National Crime Prevention Strategy of the South African government is that '[c]rime prevention is seen as important for its own sake, but also because of the role it plays in creating an environment for economic growth and social development' (Nedcor 1996:19). In fact, it is widely believed (Johns 1994, Barker 1995) that for large scale economic growth to be realised, a peaceful environment must be maintained. 'The tidal wave of crime is not only squandering thousands of lives and destroying our quality of life, it is threatening our economic future. After decades of sanctions, South Africa

desperately needs foreign capital to revive the economy and reduce unemployment. But many potential investors are holding back' (Barker 1995:36). Barker (1995:37) also points out that the tourist industry is being negatively affected as tourists feel unsafe in South Africa.⁴

The South Africa Foundation (1996:34) emphasises that crime and political instability are the most important concerns of potential foreign investors. However according to the Nedcor report (1996:58-62), a survey of foreign companies with some interest in South Africa showed that crime and violence are not important factors in investment decisions regarding South Africa and hence higher levels of crime and violence do not divert investment. This is partly due to 'the ability of foreign investors to see the crime levels, as they are likely to affect their investment, in a more global framework, and make comparative judgements' (Nedcor 1996:61). And also due to the fact that the majority of foreign investors surveyed did not consider the high crime rates as a permanent phenomenon (Nedcor 1996:60). Notwithstanding this, the Nedcor report (1996:61) cautions that 'if "ordinary" crime and violence rises to extremely high levels, this can be interpreted as displaying a lack of political will and competence on the part of the government to govern the country effectively. Investors are likely to interpret this as increased political instability. Similarly, if the populace begins to take the law into its own hands and/or begins a series of demonstrations to protest government's inability to deal with crime'. It, however, cannot be disputed that presently crime distorts investment patterns across geographical regions in South Africa (South Africa Foundation 1996:35). Firms prefer to locate in, or relocate to lower crime areas, which are most often wealthier areas and thus the economic inequalities between areas are reinforced. 'Indeed, the introduction of developmental resources into poor communities in these circumstances often creates crime, corruption and violence as various organized groups seek to siphon off the funding for their own purposes' (Nedcor 1996:14).

Domestically crime also has a negative impact on economic growth, which is partially reflected by the disproportionately large number of people emigrating and the increasing foreign investment of South Africans. The perception 'that the new democratic government

is "soft" on crime' (Nedcor 1996:14) has led to increased emigration of skilled South Africans that are internationally mobile. According to the 1996 Nedcor report, 1.8 percent of households surveyed indicated that they had considered emigrating as a result of crime, this constituted nearly 9 percent of the independent professionals (1996:10). Furthermore, crime was mentioned by South African businesses as the most important factor discouraging fixed investment or the expansion of business in South Africa (Nedcor 1996:50-51).

Crime prevention is an important factor in enabling the economic growth that is desperately needed in South Africa but this relationship is also believed to be bidirectional.⁵ Accordingly a more effective crime prevention strategy is, not only expected to foster economic growth in the first instance, but also to have a secondary effect in terms of a further reduction in crime accompanying economic growth which is perceived to be more equitable.

Even if the law was absolutely fair in terms of definition and application, it would be unjust in its consequences if the social, political and economic inequalities in South Africa remain as they are likely to result in crime⁶, thereby undermining the functioning of the criminal justice system. In addition the economically disadvantaged may feel that if society accepts no responsibility in respect of their situation, they are relieved of the moral obligation to obey the law. Economic growth, particularly regarding its potential to reduce the existing economic inequalities, therefore appears to be a crucial factor in crime prevention.

On a micro level crime affects South African victims directly. According to the victimization studies conducted in the mid 1990s (Glanz 1994:14, Nedcor 1996:7-8), approximately a quarter of the households surveyed had experienced crime. In the first national victimization study in 1997, 21 percent of households indicated that they had experienced crime (Hirschowitz et al. 1998:iii). 'There is little doubt that business is the largest organized grouping suffering from crime and violence. Government is experiencing high levels of fraud and corruption, but this is internal and not accompanied by violence' (Nedcor 1996:62). On average, managers surveyed reported experiencing crime in a business context three times more often than in a domestic context (Nedcor 1996:46). Official crime statistics, however,

probably do not reveal the true situation as '[i]t is estimated that underreporting of crime in South Africa could be as high as 50%' (Nedcor Executive Summary 1996:2).

Besides the direct effects on victims, crime has additional secondary effects related to the fear of crime that all potential victims experience. In 1995 Barker (1995:36) found that 72 percent of South Africans feared being attacked in their homes and 62 percent feared being burgled. In a survey conducted in 1995 (Nedcor 1996:8-9), 46.4 percent of the respondents indicated that it was very probable or probable that they would be victimized in the next twelve months, White and Asian respondents were more fearful on average. It was apparent that although many were uncertain, only a small minority of citizens considered it unlikely that they would be victimized. The survey (Nedcor 1996:47-48) also considered businesses' fear of crime. 'The results show that 50% or more of all categories of business "feel" intensely or constantly at risk of becoming victims of crime' (Nedcor 1996:47).

This fear of crime is significant as it imposes psychological costs on potential victims that result in changes of personal habits and attitudes, that is life styles, in order to avoid crime. According to Glanz (1994a:29-30), 50.5 percent of the respondents in a 1992 survey reported having changed their life styles to avoid crime. The greatest avoidance behaviour was reported by Asian respondents, followed by White, Black and Coloured respondents. The 1995 survey conducted by Nedcor (1996:10) produced similar results, 49.5 percent of interviewees indicated that they had assumed life style changing activities to protect themselves against crime. The avoidance behaviour of the business sector in South Africa was also noted - 'up to 9% of companies have restricted their exposure to the market because of exposure to crime. This includes closing down operations, restricting clients ... ,closing down premises or shifting routes' (Nedcor 1996:47).

Given the high crime rates in South Africa, it is therefore not surprising that '[o]verall, 46% of the population rated crime as the most serious national problem, with a range of 44% in the black community to 58% in the white community' (Nedcor 1996:72). In 1995 this was a relatively new phenomenon as '[i]n earlier surveys of public opinion using the same or similar questions, issues such as unemployment, housing, education and incomes were

consistently most predominant, except among whites, who have for some time been concerned about crime' (Nedcor 1996:8). Essentially a more effective crime prevention policy is desirable for two reasons; on a macro level, to foster economic growth and on a micro level, to reduce victimization and thereby allay the fear and insecurity related to crime.

It is clearly evident that the implications of crime in South Africa can never be dismissed as trivial. However in order to fully appreciate the effect of crime, the costs that it imposes on South Africans must be spelled out. The economic costs of crime to society are traditionally divided into three categories: damage costs, the costs of apprehension and conviction of criminals and punishment costs.⁷ Although Becker (1976:42) does not define the damage cost of crime, he implies that damage costs relate to the losses society experiences from the occurrence of crime. It is important to bear in mind that all members of society experience losses owing to criminal activity, not only the direct victims. Damage costs include the: loss of and damage to property, injury of victims, loss of life, psychological costs of crime, private costs of protection and insurance, private costs of apprehending criminals and costs relating to involvement in the administration of the criminal justice system. In all calculations the costs to criminals of committing crime will be ignored.⁸ The costs of apprehension and conviction are determined by the vast inputs required to maintain the police force and the judicial system. Finally, the punishment costs borne by society in order to execute punishment must be included.⁹ The extent of the cost of punishment depends on the type of punishment imposed. Often there are additional costs to society as the families of many prisoners require financial assistance of state welfare grants.

According to the Nedcor report (1996:73), the damage costs of crime to households and businesses in South Africa amounted to R31.3 billion in 1995. It should also be noted that '[m]any respondents could not estimate ... their losses - hence the figures emerging are somewhat of an underestimate' (Nedcor 1996:9).¹⁰ The expenditure of the entire criminal justice system for 1995/6 was just under R14 billion (Department of Finance 1999:163,182&194). Thus the total cost of crime in South Africa in 1995 is estimated at just under R45.3 billion. As the overwhelming majority of countries worldwide rely mainly on the criminal justice system for public crime prevention, the costs to society of state crime

prevention largely relate to the operational costs of this system. If the crime prevention strategy is broader and includes the activities of other government agencies, then the other categories of public expenditure involved will need to be included in the calculation of the total cost of crime.

Unfortunately no other estimates of the damage costs of crime in South Africa are available and therefore it is not possible to estimate the total cost of crime in other years. However, it is informative to consider the expenditure on the criminal justice system over time. From Table 1.4 below it is clear that expenditure in every department has grown rapidly and that this trend is expected to continue. The figures for the last three years in the table are estimates but represent funds which are committed to the criminal justice system in terms of the three year budget planning cycle of the National Treasury (previously the Department of Finance).

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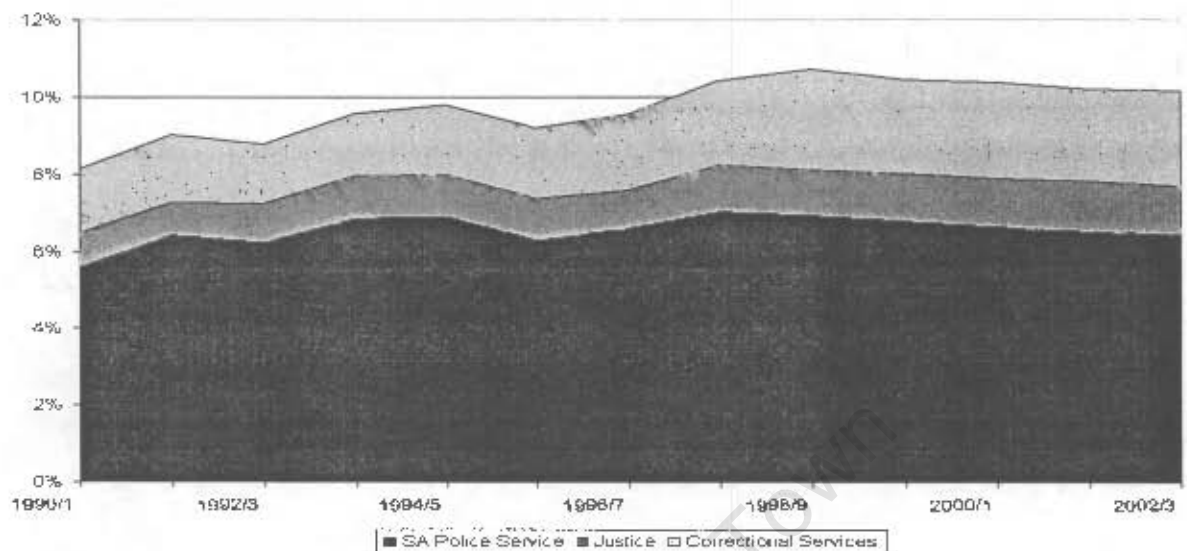
Table 1.4: Total Expenditure and Budget for the Criminal Justice System and the Nation (in millions of nominal rands)

	South African Police Service	Justice	Correctional Services	Criminal Justice System	National Expenditure
1990/1	4 632	740	1 382	6 754	82 933
1991/2	6 222	820	1 699	8 741	96 803
1992/3	7 357	1 205	1 801	10 363	118 097
1993/4	8 853	1 449	2 091	12 393	129 405
1994/5	9 971	1 601	2 584	14 156	144 643
1995/6	9 967	1 704	2 862	14 533	158 068
1996/7	11 635	1 773	3 425	16 833	176 291
1997/8	12 849	2 211	3 962	19 022	182 658
1998/9	13 980	2 392	5 243	21 615	201 534
1999/2000	14 651	2 694	5 198	22 543	216 041
2000/1	15 457	2 981	5 788	24 226	233 452
2001/2	16 386	3 247	6 017	25 650	251 478
2002/3	17 173	3 377	6 514	27 064	266 671

Adapted from: Department of Finance. *Budget Review* (Pretoria), 1995, pp B67-B68; 1996, pp B63-B64 & 2000, p 136.

In the figure below expenditure on the criminal justice system is considered as a proportion of national expenditure. It is evident that the criminal justice system in South Africa is allocated a large percentage of national expenditure and that this has grown from 8.1 percent in 1990/1 to 10.4 percent in 1999/2000. This ratio peaked at 10.7 percent in 1998/9. It is expected to fall to 10.1 percent by 2002/3 and therefore is not expected to decrease substantially in the medium term. From 1997/8 to 1999/2000 the departments of Justice and Correctional Services gained a greater share of the criminal justice system budget, at the expense of the South African Police Service.

Figure 1.1: Criminal Justice System Expenditure as a Proportion of National Expenditure



Adapted from: Department of Finance, *Budget Review*, 1995, pp B67-B68; 1996, pp B63-B64 & 2000, p 136.

As these costs are opportunity costs and calculated in currency terms, they reflect the expenditure that must be sacrificed in other areas in order to allocate funds to remedying the effects of crime and to crime control and prevention. Essentially all these activities are considered to be inherently non-productive forms of employment. Yet it is obvious that in South Africa with crime escalating at a considerable rate, public expenditure on crime will not decrease in the foreseeable future and is likely to continue to increase unless a more effective crime prevention policy is adopted.

1.3 THE CRIMINAL JUSTICE SYSTEM AND OTHER RESPONSES TO CRIME IN SOUTH AFRICA

In a modern society the maintenance of law and order is the ultimate and exclusive responsibility of the state, and the institutional framework established to perform this task is the criminal justice system. 'In fact, providing for the safety and security of citizens is the most basic and fundamental duty of any government - which is why people are willing to give the government the right to use force against criminals to protect citizens who have not committed crimes' (Nedcor 1996:16). In the case of criminal law, the state initiates action because the crime is considered serious enough to threaten, not only the immediate victim,

but also the welfare of the entire society. In order to provide effective crime prevention it is the duty of the government to ensure that: the behaviour defined as criminal is agreed upon by society at large, the enforcement of the law is efficient and effective and the application of the law is fair.

Justice must be based on the rule of law in a democratic society. The formal system of laws formulated are the result of a political process and do not constitute a natural form of social control. Essentially there are two approaches to the types of behaviour defined as criminal (Reid 1988). The consensus approach regards the law as the formalisation of the views and values of members of society and therefore the law is obeyed out of respect. In terms of the conflict approach the conflict in society is resolved when the most powerful groups achieve control and the law thus becomes a symbol of their morality, it is then only obeyed out of fear of punishment. The problems relating to fallaciously defining behaviour as criminal are largely avoided in this research as all the crimes included in the empirical analysis, except drug-related crimes and driving under the influence of illegal substances, relate to behaviour which is normally defined as criminal in any society. That is, with respect to the crimes considered South Africans share a common and binding legal culture.

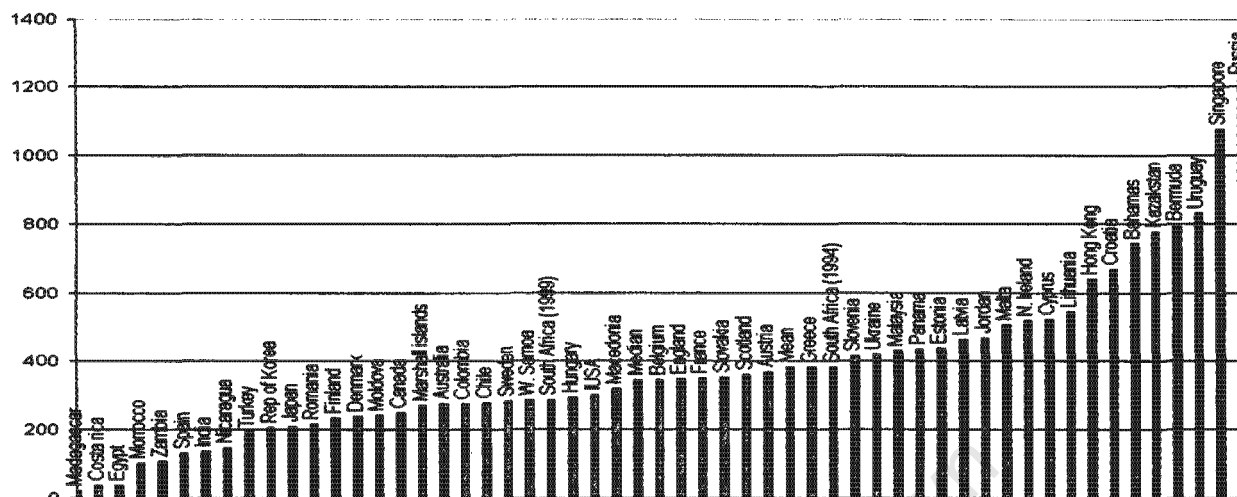
Throughout the South African criminal justice system many factors hinder the efficient and effective enforcement of the law. To the extent that the enforcement mechanism in place is not efficient and effective, the government fails because an incentive is created for some citizens to break the law while others obey it. A detailed discussion regarding the specific problems which plague each of the departments within the South African criminal justice system follows.

The public perception regarding the police is very important because the greater the satisfaction with policing, the lower the fear of crime and the psychological costs related to crime - irrespective of the level of crime. A survey conducted by Reader's Digest (Barker 1995:37) showed that in 1995 a small proportion of interviewees were of the opinion that policing in their area was satisfactory: 47 percent of Whites, 37 percent of Blacks, 25 percent of Coloureds and 24 percent of Asians. More recently, in the first national

victimization survey 38 percent of the respondents indicated that they were satisfied with policing, 23 percent were neither satisfied nor dissatisfied and 40 percent were dissatisfied. 'A rather small proportion of respondents believed that the police had become more effective (26%) since that date [April 1994 elections], while a larger proportion believed that they had stayed the same (32%), and an even larger proportion believed that they had become less effective (42%)' (Hirschowitz et al. 1998:vi).

The dissatisfaction with the South African Police Service appears to be largely attributable both to the fact that there are insufficient police officers and that they are not very efficient. From the figure below it is evident that in 1994 South Africa had a police officer to citizens ratio just above the mean of the countries considered in the international comparison. However, by 1999 the position had weakened and the South African ratio was considerably lower than the average, even lower than the median ratio.¹¹ The conclusion drawn by the South Africa Foundation (1996:38) remains valid - South Africa has a modest police presence, given that it is a developing country and one with a high crime rate. In order to generate Figure 1.2, the 1994 information provided in the United Nations' report was compared to South African data.

Figure 1.2: Police Officers per 100 000 Citizens



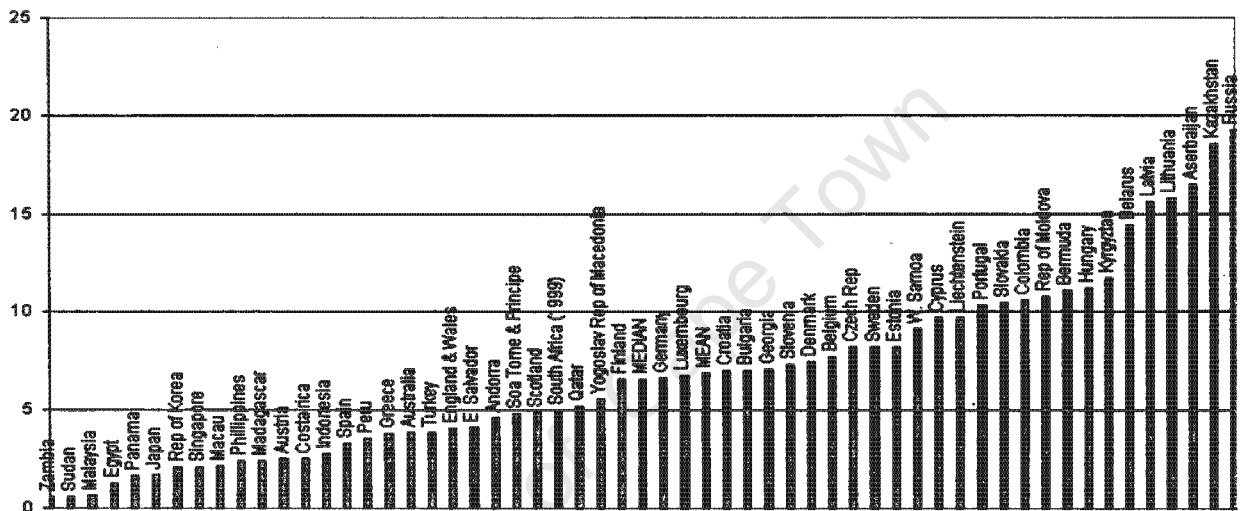
Adapted from: United Nations, Global Report on Crime and Justice, 1999, pp 319-321 and South African Police Service data.

The inefficiency of police officers can be ascribed to poor training, inexperience, a lack of equipment and inadequate operational information and information technology (South Africa Foundation 1996:37). In addition, effective managerial structures are not in place within the South African Police Service resulting in the 'difficulty in balancing transformation of the service with maintaining levels of professional performance' (Nedcor 1996:76). This situation is worsened still by the low level of morale¹² and the corruption of officers. All of these factors lower the probability of criminals being arrested for the crimes they commit and essentially provide an incentive for increased criminal activity.

It is widely acknowledged that the Department of Justice in South Africa is not able to manage the large case load. Of particular concern is the number of case dockets that disappear thus preventing important cases from going to court. This situation impacts directly on the efficiency and effectiveness of law enforcement as state prosecutors are responsible for many decisions which influence the probability of criminals being prosecuted, convicted and punished. Presently 'the rate of conviction of criminals is extremely low and many are freed for lack of a coherent case against them' (Nedcor 1996:13). The figure below clearly indicates that the prosecutors to citizens ratio in South

Africa in 1999 (the only year for which reliable information was available) was substantially lower than the 1994 mean and median ratios, calculated in the United Nations' report. This is disconcerting, given the high level of crime in South Africa and the large backlog on court rolls. The South Africa Foundation (1996:39) emphasises that the substantial staff shortages contribute to the current delays in bringing criminals to court.

Figure 1.3: Prosecutors per 100 000 Citizens



Adapted from: United Nations, Global Report on Crime and Justice, 1999, p277 and Department of Justice data.

The main concern of the South African public, however, appears to be that courts must ensure that sentences are sufficiently stringent to promote deterrence and make punishment effective. Barker (1995:37) found that 48 percent of the respondents in his 1995 survey were of the opinion that prison sentences should be longer. "[A]s things stand at the moment, crime does pay" (Vogelman in Barker 1995:38). Yet the South Africa Foundation (1996:37) found that the length of prison sentences awarded between 1977/78 and 1993/94 had risen substantially, although a slightly lower proportion of convicted criminals received prison sentences. From the table below it is evident that in more recent years the length of prison sentences have continued to increase. The only year in which the average sentence length decreased, and only marginally, was 1997. Clearly the cost of punishment to criminals who are convicted and sent to prison has increased over time.

Table 1.5: Average Prison Sentence Awarded by the Courts

	1995	1996	1997	1998	1999
Average Sentence in Years	5.901	5.99	5.987	6.498	6.665

Source: Department of Correctional Services data.

Obviously sentencing is also the major concern of South Africans regarding the efficiency and effectiveness of the Department of Correctional Services. Of particular concern is the sentence effectively served, reductions in sentences granted by courts lower the cost of punishment for committing crime.

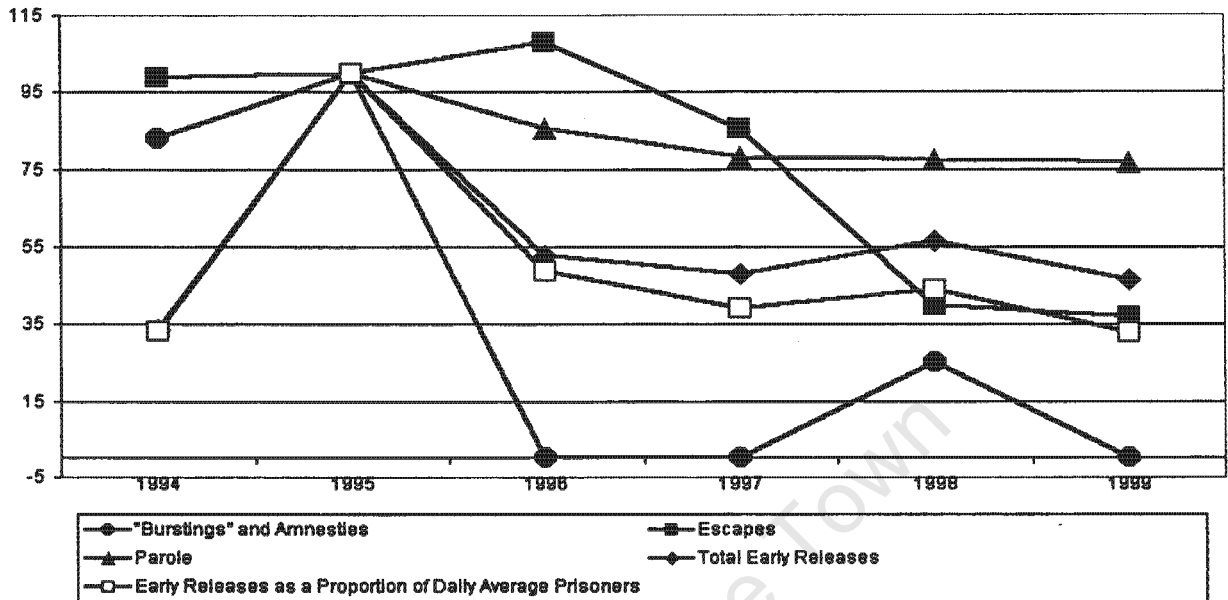
Table 1.6: Prisoners Exiting Early as a Proportion of Average Prisoner Population

	1994	1995	1996	1997	1998	1999
Proportion of Early Releases	25%	75%	37%	30%	33%	25%

Adapted from: Department of Correctional Services data.

From the table it is apparent that in the six years considered, the proportion of prisoners released before the completion of their sentence has never been lower than 25 percent, even reaching 75 percent in 1995. Figure 1.4 below clearly illustrates this, and shows the level of total early releases and the individual categories comprising it, using 1995 as the year of comparison. It should be noted that early releases due to "burstings" and amnesties occur sporadically. Prison escapes appear to have decreased considerably in the last three years. It is also clear that the number of parolees decreased substantially in 1996 and 1997 and has remained stable since then, even though the prisoner population has increased rapidly. According to the Nedcor report (1996:76) the parole system is dysfunctional. Unfortunately there seem to be few punishment alternatives to imprisonment, although 'it is estimated that South Africa has a 94% recidivism rate' (Nedcor 1996:5).

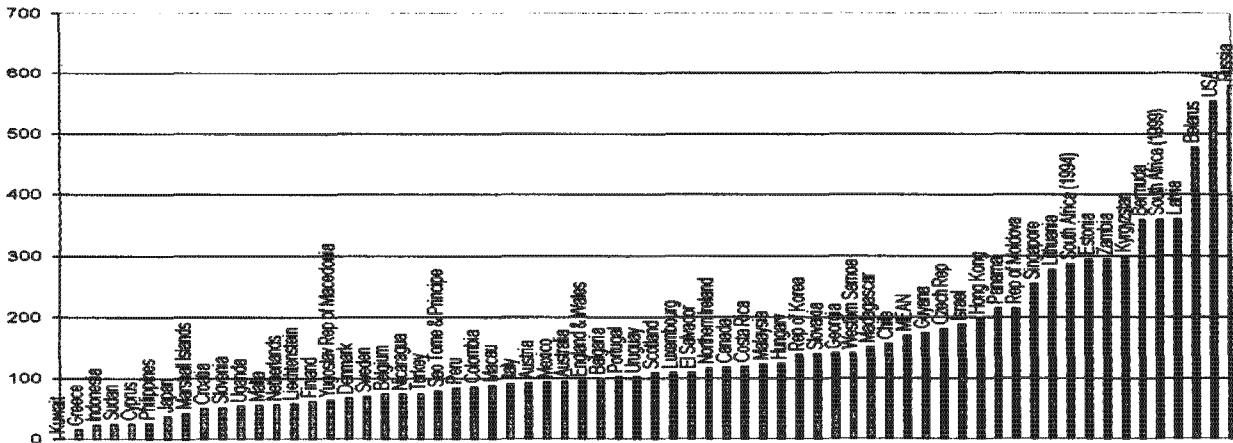
Figure 1.4: Early Prisoner Exit (1995=100)



Adapted from: Department of Correctional Services data.

One of the main reasons for reducing the sentence effectively served by prisoners is the size of the prisoner population in South Africa. Although a large proportion of prisoners do not serve their full sentence, in the figure below it can be seen that the prisoners to citizens ratio in South Africa in 1994 was still substantially higher than the average 1994 ratio determined by the United Nations. In 1999 the South African ratio was even higher, only four of the sixty six other countries included in the comparison had a higher ratio.

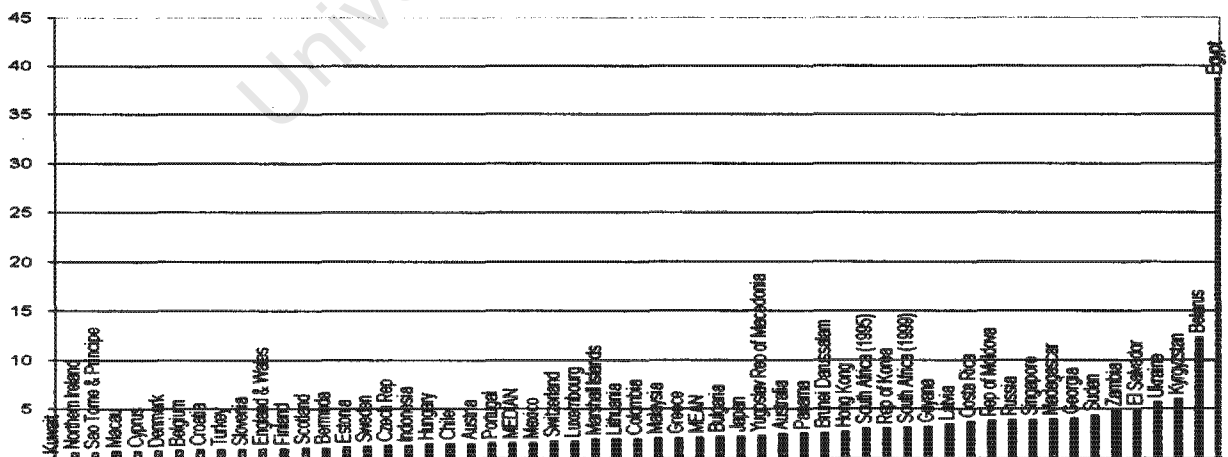
Figure 1.5: Prisoners per 100 000 Citizens



Adapted from: United Nations, Global Report on Crime and Justice, 1999, pp 329-330 and Department of Correctional Services data.

From the figure below it is obvious that, as in the other departments of the criminal justice system in South Africa, Correctional Services has a modest staff complement. The ratio of convicts to corrections personnel in 1995 was above the mean and median ratios calculated by the United Nations for 1994. In 1999 the ratio in South Africa was higher than it was in 1995.

Figure 1.6: Convicts per Correctional Service Staff Member

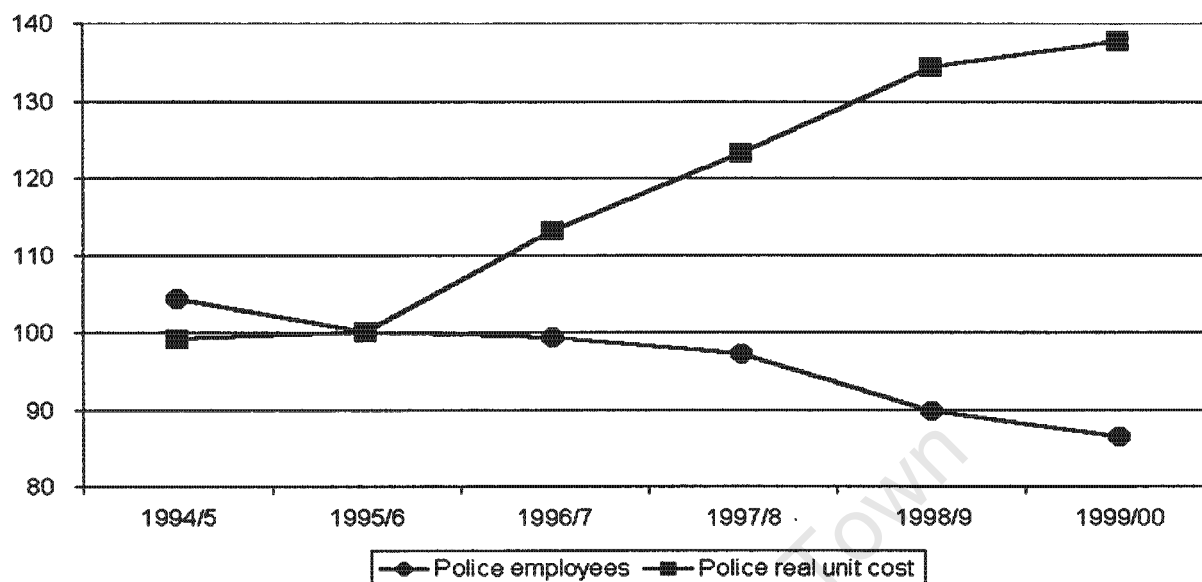


Adapted from: United Nations, Global Report on Crime and Justice, 1999, p300 and Department of Correctional Services data.

Many recommendations have been made to address the problems outlined above and ultimately improve the efficiency and effectiveness of the criminal justice system in enforcing the law. Largely they have constituted the elements in the current public debate surrounding more effective crime prevention policy. The suggestions specific to each department will be discussed in turn.

'[T]he police force urgently needs to improve its resources, with better vehicles, information and information technology, and more trained and experienced staff (South Africa Foundation 1996:38) the probability that criminals will be arrested for the crimes they commit will increase. As an initial measure, it has often been proposed that more police officers should be employed, specifically in the geographical areas and crime units that have the biggest staff shortages and that they be better paid at lower and middle levels (Nedcor 1996:79). It is believed that this will improve productivity and reduce the incentive for corruption as a means of supplementing income. The South African Police Service has addressed the problem of low salary levels, from 1995/6 to 1999/2000 the average real salary of police officers increased continually, by almost 40 percent in total. The figure below shows this and also clearly indicates that the number of officers has decreased systematically over the period. There appears to have been a trade-off between increased salaries and increased personnel. A fundamental objective of the South African Police Service should be to improve its image as a professional career option, this would require changes in recruitment and training of personnel (Nedcor 1996:79).

Figure 1.7: Police Employees and Average Real Salary (1995/6=100)



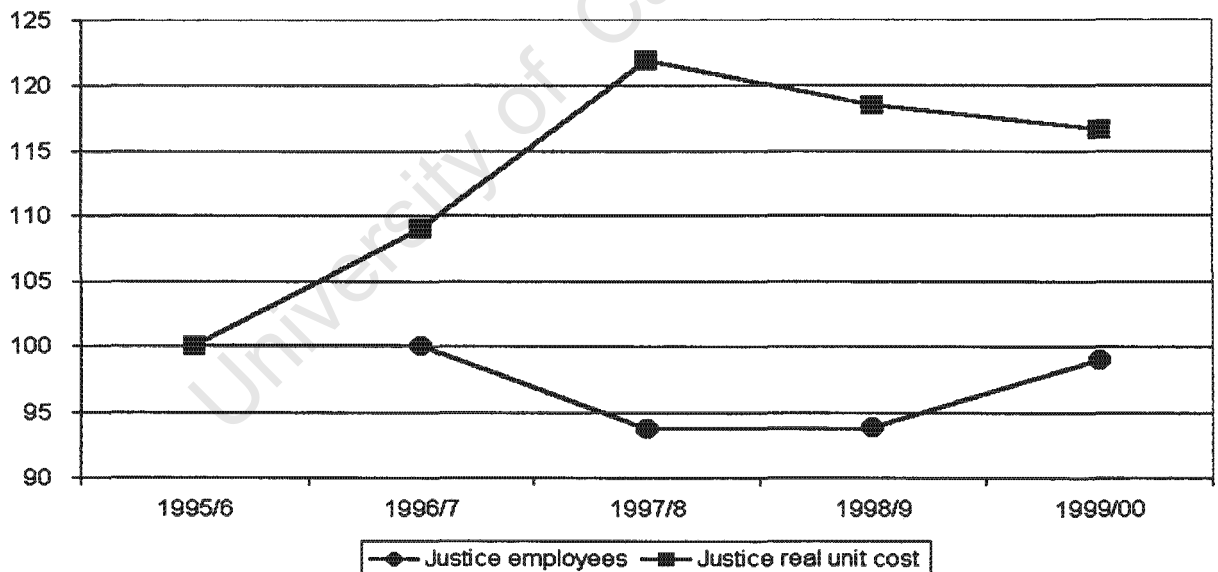
Adapted from: South African Police Service data.

Budget constraints make it very difficult to achieve increases in the quantity and quality of resource inputs, all of the above suggestions involve additional expenditure on the police force. However, some changes may not involve additional costs. According to the Nedcor report (1996:79), one of the main objectives of the South African Police Service should be 'improving management of the police services using essentially the same personpower'. The efficiency of most police forces can be improved by allocating time more efficiently¹³, implementing effective codes of practice regarding different categories of crimes and reducing the amount of non-law enforcement work that is allocated to the police (Fyfe 1993). 'Better coordination between divisions, the decentralisation of authority (currently highly centralised), and an expansion in the role of civilians in the police force would [also] help' (South Africa Foundation 1996:38).

There have also been numerous recommendations regarding the improvement of efficiency and effectiveness in the judicial system. As is the case for policing in South Africa, it is generally emphasized that the Department of Justice 'needs to improve its resources' (South Africa Foundation 1996:38). 'The policy of eliminating racial and gender biases [in the personnel complement] has inevitably resulted in the loss of experienced prosecutors -

a trend which is likely to continue ... an improvement in the prosecution and conviction rate is unlikely in the short and medium term' (South Africa Foundation 1996:39). Given this situation, retaining and appointing experienced staff is the one aspect of the functioning of the judicial system that must be singled out as being most important (Nedcor 1996:79). It is also acknowledged that the low salaries paid by the department must be reconsidered (Nedcor 1996:76). In Figure 1.8 below the loss of personnel is clearly evident. Although the number of employees in the Justice Department increased in 1999/2000, this level is still below that of 1995/6. The average real salary of justice personnel increased over the period considered, indicating some improvement in salary levels, but decreased in the last two years. The trade-off between increasing personnel and salary increases also appears to be evident in the Department of Justice.

Figure 1.8: Justice Employees and Average Real Salary (1995/6=100)



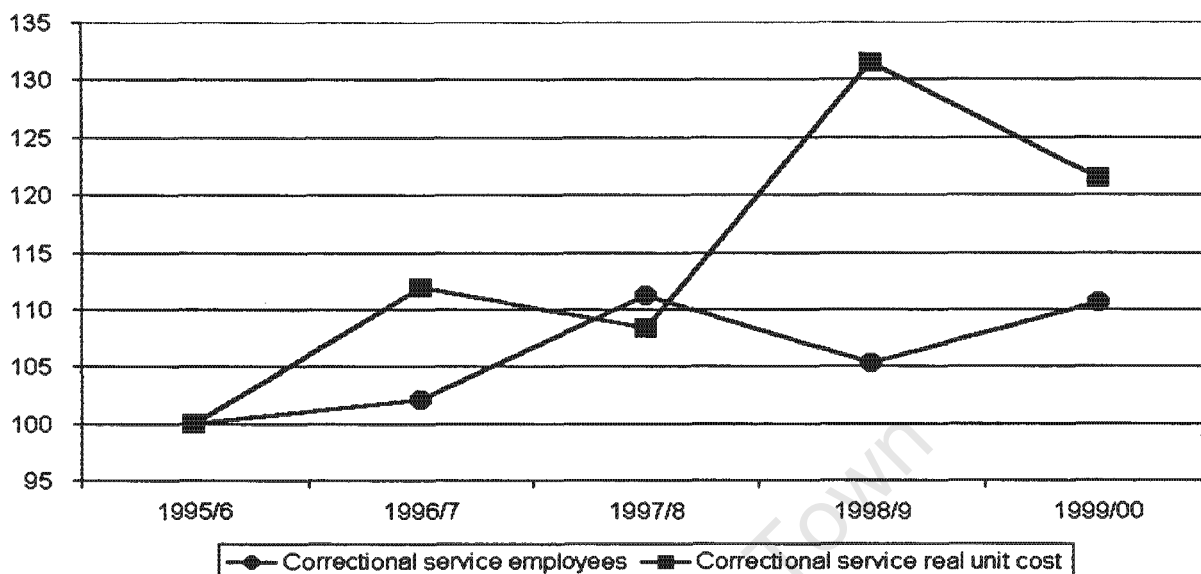
Adapted from: Department of Justice data.

The most important concern of the public regarding the judicial system, as stated above, is that the punishment awarded to convicted criminals be sufficiently severe. It was noted above that on average sentence lengths have continually increased. It is not known whether this upward trend will continue, however, it must be noted that an increase in the length of

sentences only has a marginal effect on the crime rate. And that an increase in the length of sentences is bound to have system effects, such as an increase in the number of accused pleading not guilty and an increase in the number of appeals, which will increase the workload of the courts.

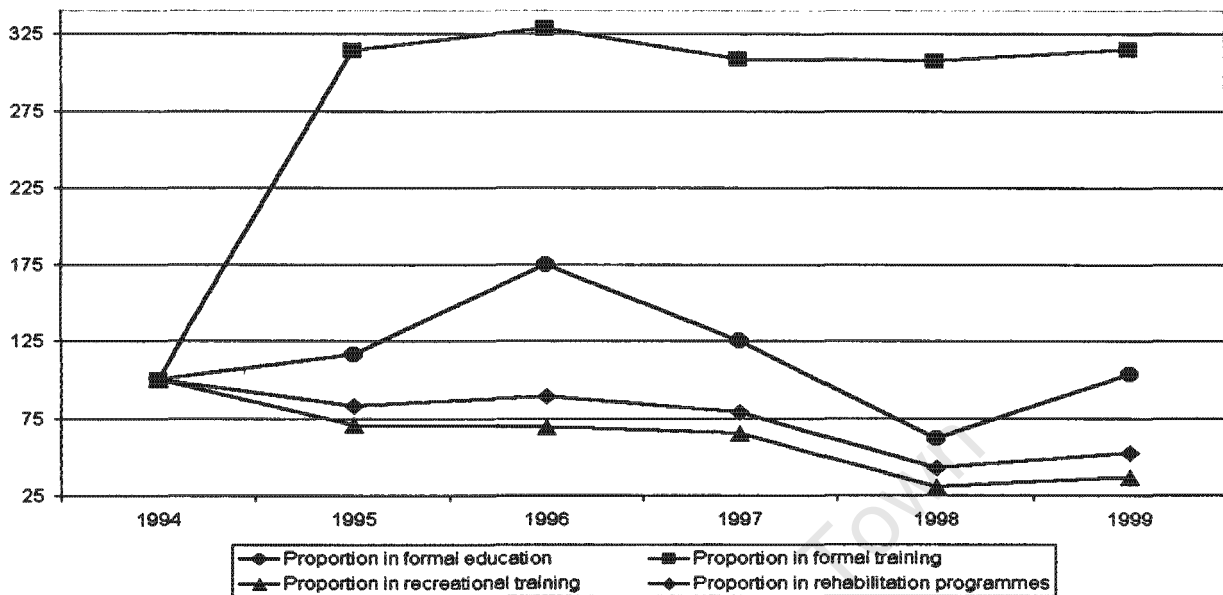
Similarly it must be recognised that increasing the length of sentences meted out by courts will result in a greater prison population, which presently cannot be accommodated by the Department of Correctional Services. The prison population will also be increased if prisoners are made to serve their sentences in full. While it is generally acknowledged that the resources of the prison system need to be improved to enhance effectiveness and efficiency, the South Africa Foundation points out that this is necessary to provide the appropriate prison facilities which do not constrain prison sentences (1996:38). In recent literature, various cost-cutting methods in the building and running of prisons have been suggested. Calls to privatize non-core functions and even imprisonment itself are now being seriously considered worldwide. It has also been recommended that prisoners be made to work¹⁴, in order to subsidize the costs of running prisons and provide an environment for the rehabilitation of prisoners. In Figure 1.6 on page 21 above it was shown that in South Africa the convicts to correctional personnel ratio is relatively high, therefore it is evident that the size of the personnel complement is an important consideration for the department. From 1995/6 to 1999/2000 the total number of employees increased, as did the average real salary earned. This can be seen from the figure below, although it should be noted that the increase in salaries was greater over the period. Again, the inverse relationship between personnel increases and salary increases is evident.

Figure 1.9: Correctional Service Employees and Average Real Salary (1995/6=100)



Adapted from: Department of Correctional Services data.

In 1996 the Nedcor report (1996:79) recommended that one of the initial improvements in the criminal justice system be more intensive rehabilitation of criminals. It can be seen from the figure below that the proportion of prisoners participating in recreational training decreased dramatically since 1994. Because involvement in this programme was initially, by far, much greater than in any other, this decrease caused an equally dramatic decrease in the overall proportion of prisoners in rehabilitation programmes. However, the proportion of prisoners involved in formal training increased substantially over the time period, particularly in 1995. The 1999 increase in participation in formal education is notable, given the decreases in the previous two years. It is clear that much needs to be done in order to improve the efficiency of the prison system and that the system must be considered in the broader context of the efficiency of punishment in South Africa.

Figure 1.10: Proportion of Prisoners in Rehabilitation Programmes (1994=100)

Adapted from: Department of Correctional Services data.

At the beginning of this section it was noted that for crime prevention policy to be effective, the application of the law must generally be perceived to be fair. Unfair application of the law in South Africa largely relates to racial discrepancies in investigating reported cases, in the treatment of suspected criminals, in access to legal assistance and in the sentence received when convicted.¹⁵ Glanz (L. Glanz, pers. comm. 5 February 1996) is of the opinion that the extent of the past unfairness in applying the law is uncertain but that it certainly did exist. She also believes that the degree of discrimination would have been the same for all categories of crime. Most complaints relate to the fact that for just over forty years the South African police were required to implement oppressive apartheid legislation (Barker 1995:35, Glanz 1994:53, Shaw & Gastrow 2001:249). 'The utilisation of the machinery of the South African state to enforce apartheid has created deep distrust of key institutions such as the police and legal system' (South Africa Foundation 1996:36). Added to this are the numerous allegations of corruption, clearly exacerbating unfairness in law enforcement.

As law enforcement decisions are largely left to the discretion of those administering the law, these decisions are open to abuse and allegations thereof, or at least, of arbitrariness.

In order to bring credibility to the system, all stakeholders must participate in devising explicit decision-making guidelines. However, it should be noted that it is not 'wise to attempt to remove all discretion in the criminal justice system. The real question is where the bounds of that discretion will lie and how discretion may be checked' (Reid 1988:472). It is imperative that the decision-making guidelines developed in South Africa pay specific attention to rectifying racial biases. This is a matter of importance as national anti-crime campaigns will not work if the corruption of bureaucrats, police and other criminal justice system personnel continues and the criminal justice system does not respond in a consistent manner to crime.

Many criticisms of the functioning of the criminal justice system regarding efficient and effective law enforcement and fairness in applying the law have been mentioned above and many recommendations have been made in order to remedy the situation. Ultimately, it must be recognised that '[t]his [criminal justice] process should be conceptualised as a single system, and should therefore be managed in an integrated way' (Nedcor 1996:21). Owing to the horizontal fragmentation of the South African criminal justice system into different departments and the vertical fragmentation in terms of governance areas, there are conflicting goals within the system which lessens its crime prevention impact. Effective law enforcement requires, not only the efficient operation of the departments of Safety and Security, Justice and Correctional Services, but also cooperation and coordination between them.

To some extent this has been achieved in South Africa, if only on a national level, by the current Integrated Justice Sector initiative that was established in 1996 and has undertaken many collaborative projects aimed at finding ways of improving efficiency throughout the criminal justice system. The recommendations in this regard have largely not been applied throughout the country, owing to budgetary constraints. However, this is necessary if the overall probability of punishment and the cost of punishment are to comprise an effective crime deterrent. Not only must the goals of the entire criminal justice system be coordinated and ad hoc measures be avoided, the discretion inherent in the criminal justice system must

be properly used in order to be functional for the system. To ensure this, guidelines regarding decision-making and the exercising of discretion must be coordinated and explicit.

When considering increases in the different probabilities comprising the overall probability of punishment and/or the cost of the median sentence in order to decrease the crime rate, it is of utmost importance for decision makers to recognise that all departments and procedures within the criminal justice system create a system effect (Reid 1988:369). Increasing the probability of arrest increases the overall probability of punishment but it also increases the activities and operational costs of all departments in the criminal justice system. The South Africa Foundation (1996:40) stresses that reforms in criminal justice system departments should be 'simultaneous and coordinated', to ensure that changes in any one department are most effective as they are reinforced by the changes in other departments.

The criminal justice system was specifically set up as the instrument governments would make use of to manage crime and thereby protect the rights of citizens. There are many criticisms of the criminal justice system, so many that its efficiency and effectiveness as an instrument for crime prevention is being questioned. After all, '[w]hat is the purpose of an elaborate system of investigation, analysis, and decision-making if the remedy applied fails palpably to remedy, even inflicts harm on the [criminal], and does little or nothing to assuage the victim and the aroused public?' (Blom-Cooper 1986:280). This view is particularly alarming given that most countries are presently mainly reliant on the criminal justice system for crime prevention.

In South Africa it is echoed, in fact the South Africa Foundation (1996:32&37) points out that the probability that a criminal will be convicted and punished for a crime committed has decreased over time. '[O]nly about one crime in six leads to a conviction - and the conviction rate fell by 11 percent over the 1989-93 period' (South Africa Foundation 1996:32). Approximately 70 percent of those convicted were sentenced to imprisonment, this proportion was lower than in previous years. Subsequently the findings of the Nedcor report (1996:5) were similar, except that the probability of being imprisoned once convicted

had decreased further, to approximately 47 percent. The fact that only approximately 22 percent of those imprisoned received sentences of longer than two years was highlighted.

Table 1.7: Probabilities Relating to the Criminal Justice Processing of a Reported Case

	1995	1996	1997	1998	1999
Probability of Case to Court	25.13%	25.18%	24.97%	23.41%	23.50%
Probability of Conviction	16.31%	39.11%	38.81%	38.70%	35.95%
Overall Probability of Conviction	4.10%	9.85%	9.69%	9.06%	8.45%

Adapted from: South African Police Service data.

In Table 1.7 more recent information is provided concerning the various probabilities. In the first row the probability of prosecution for a crime committed is shown. The probability of arrest could not be calculated as information in this regard is not available. Row two indicates the probability of conviction, given that the case has gone to court. Row three summarises the above two rows, indicating the probability of a reported case of crime resulting in conviction. Owing to a lack of information, it was not possible to calculate the probability of incarceration once a criminal had been convicted. It can be seen from the table that the overall probability of conviction in 1999 was 8.45 percent - approximately half of the previously reported value of one in six (16.67 percent). The overall probability of conviction was, however, much higher than its 1995 level, although it was lower than it had been in the interim years. The same trend is evident when the probability of conviction, given that a case has gone to court, is considered. It is noteworthy that the increase from 1995 to 1999 is bigger than is the case for the overall probability of conviction. This is due to the fact that the probability of a reported case going to court was lower in 1999 than in 1995.

Given the above government failures with respect to the functioning of the criminal justice system, it is obvious that the management of the system is an onerous task. It is further complicated because the criminal justice system cannot be completely managed internally. Input from the broader community is essential as the system must be accountable to society

at large. Currently in South Africa it is thought that the private responses to crime, that is individual and/or community responses¹⁶, that do exist are not only fulfilling their complementary role in crime control, but are also increasingly being substituted for criminal justice system activities. In 1996 it was noted that 'the private security industry is booming and now employs over 450 000 people' (Nedcor 1996:74), it 'is now larger than the SAPS [South African Police Service]' (Nedcor 1996:56). This situation is a direct result of the inability of the criminal justice system to curb the increasing crime rate.

Fisher (1993:177-207) notes that individual responses to crime relate to avoidance behaviour and "target hardening", making it more difficult for criminals to commit the crime.¹⁷ Most people and organisations are not prepared to do anything else in their personal capacity to prevent crime because law enforcement is largely a public good and thus there is a free-rider problem in providing further crime prevention. Individual responses to crime in South Africa will not be considered in this study as the emphasis is on controlling the crime faced by society at large and these personal measures may not necessarily provide community safety.

Participation in community crime prevention is greater among individuals and organisations that have invested in the area and those that are committed to the community. In an attempt to improve, coordinate and formalise relations between the police and the broader community, the Constitution has made provision for the establishment of community-police forums. Community-police forums have the potential to greatly improve the effectiveness of police station decision-making and activities. Especially since they allow participation by all community organisations, even unexpected organisations such as private security companies and former members of self-protection units and self-defence units (Nedcor 1996:29). Unfortunately to date community-police forums, which have been officially setup at almost every police station nation-wide, have not been very successful. The reasons for this should receive immediate attention as policing productivity is undoubtedly improved by community responses to crime. Other joint ventures between the community and the police in South Africa include: a toll-free telephone crime reporting system called Crime Stop, neighbourhood watch organisations, citizen patrols, business watch organisations, business

improvement districts and various forms of financial assistance for local policing.¹⁸ All of these ventures are opportunity-reduction approaches, the aim being to make criminal activity less attractive.

Unfortunately '[h]istorically rooted problems with the popular credibility of law enforcement agencies and the criminal justice system have created both socially constructive and more sinister forms of informal justice. Vigilantism, gang formation and the establishment of private paramilitary interest groups are examples of the more sinister types' (Nedcor 1996:20). Although it is understandable that the broader community may feel compelled to take the law into their own hands, these acts are themselves serious crimes and could contribute to a further cycle of crime in the area. Thus the importance of an effective national crime prevention policy cannot be overemphasized as a high level of crime not only has serious social implications, but is also intrinsically criminogenic. Yet the ability of the criminal justice system, whether with or without community input, to control crime is being questioned.

In South Africa criminal justice system expenditure is almost the only public expenditure directed at controlling crime. Although in recent years crime prevention outcomes have been considered in the national budget allocation process, budget funds have been allocated to the criminal justice system and to its various departments largely on the basis of operating expenses. From Figure 1.1 on page 14 it is evident that the budgetary implications of this expenditure are not insignificant, especially for a country that has restrictive budget constraints in terms of its national macroeconomic policy. It is clear that if the recommendations that have been made in order to improve the functioning of the criminal justice system are indeed implemented, the system will be more efficient at controlling crime. It is, however, also clear that making the system more efficient will require a much greater budget allocation, although some cost savings will arise.

Owing to the fact that past expenditure on the criminal justice system in South Africa and elsewhere in the world has been substantial and yet that results in terms of crime prevention appear to be lacking, the major focus in this study will be on various other

government agencies in terms of their potential to contribute to crime reduction. Thus for the major part of this thesis the efficiency of the system will be taken as given and the focus will be on the effectiveness of the present system in crime prevention as well as the effectiveness of other government agencies in this regard¹⁹. Therefore issues raised in this section will only be addressed at the end of this study, when the efficiency of South African criminal justice system resources is evaluated empirically.

1.4 THE RATIONALE AND AIM OF THIS STUDY

'Crime is not a simple phenomenon that can be examined, described and analyzed in one piece. It occurs in every part of the country and in every stratum of society. Its perpetrators and its victims are people of all races, ages, incomes and backgrounds. Its trends are difficult to ascertain. Its causes are legion. Its cures are speculative and controversial. An examination of any single kind of crime ... raises a myriad of issues of the utmost complexity' (Labuschagne 1975:2). Forst (1993:xi) therefore emphasises that 'we badly require constructive, well-thought-out, workable treatments of crime. The social sciences have a major role to play in attending to this social need'.

Unfortunately the researched opinions of academics have not had much influence on crime prevention policies.²⁰ Yet it is essential that these opinions are considered because current policy is plagued with an increasing lack of public interest in what causes crime, rather the sentiment and appeal is '[l]et the punishment fit the crime' (Reid 1988:216). Since the 1970s there has been a renewed interest in the classical perspective in criminology. 'It has focussed on effective crime control, assuming humans to be free, rational and choice-making and hence best kept in order by increasing the risks of committing crime. In emphasising deterrence through punishment and the reduction of impunity, it can legitimately claim to be heir to the original classical position, laid down in the eighteenth century' (Roshier 1989:vii). Reynolds, an economist, states the position as follows: people commit crimes as long as they are prepared to pay the price that society charges, that is the punishment - '[t]he reason we have so much crime is that crime pays' (1990:260).

Traditionally crime prevention has been entirely dealt with via the criminal justice system. In South Africa and worldwide crime prevention policy has been directed at more public expenditure on some or all of the departments of the criminal justice system. In terms of economic theory, the policy has been to decrease the returns to illegitimate activity by increasing either the overall probability of punishment and/or the cost of the median sentence. Traditionally economists, who advocated the neoclassical paradigm, have argued that expenditure on the criminal justice system will always be more efficient in crime prevention than other types of public expenditure as it impacts solely on the crime rate. Other types of public expenditure are expensive alternative crime prevention methods as they influence everyone in society, whether they possess a criminal disposition or not. The criminal justice system has always been considered to be the appropriate agency for dealing with crime because it was devised to define, select, document and dispose of crime and criminals.

Unfortunately in South Africa and in most other countries, the public debate still centres around improvements in the criminal justice system as a means of achieving effective crime control. This is evident from the discussion in the above section concerning the inefficiencies in the operations of the various departments of the criminal justice system in South Africa. In a survey conducted by Nedcor (1996:10 & 52-53) opinions were elicited from the general public, businesspeople and people who have crime-related occupations regarding appropriate strategies to combat crime. Various improvements in the criminal justice system were suggested, upgrading the socio-economic environment was perceived to be the least important strategy (Nedcor 1996:54&55).

Worldwide it appears that this debate is too narrowly focused, in spite of restrictive budget constraints, public expenditure on the criminal justice system has been increasing and yet crime continues to increase. 'It is becoming increasingly clear that ever more criminal justice resources generally, and more prisons in particular, are by themselves no solution at all' (Forst 1993:3). Roshier (1989:115) agrees, stressing that '[n]or have any *changes* that have been made to penal methods, with a view to reducing crime, ever been clearly established as having achieved that end. Few contemporary criminologists would now deny

that the major determinants of crime rates lie outside the realm of penal policy, in the wider social, political and economic context [my italics]’.

Social, political and economic explanations and policies have not received adequate attention in crime prevention strategies. Yet although no extensive aggregate level empirical research has been undertaken in South Africa focusing on crime causation and appropriate crime prevention policy, in the research which does exist relating to public opinion on crime causation respondents indicated that the most important reasons for the increase in crime were economic. In the survey conducted by Glanz (1994:13), the economic recession and unemployment were cited as the most important reasons. In a subsequent study by Barker (1995:36) unemployment was rated as the main cause of crime by 25 percent of the respondents, and poverty was considered the most important by 21 percent. Surveyed respondents indicated clearly that there is an internalized societal hypothesis that major causes of crime are unrelated to law enforcement. Yet the current public policy debate in South Africa still primarily concerns improvements needed in the criminal justice system in order to deter crime effectively. This is true in other countries as well. This schism in public opinion is mirrored in the divide in the economic theory of crime caused by the traditional focus on the activities of the criminal justice system.

‘Perhaps more importantly, recognition of the apparently powerful effects of economic factors on crime ... may help sensitise office holders to the likelihood that economic policies ... will most likely have significant impacts on crime rates’ (DeFronzo 1983:133). State office holders also need to be equally aware of the effects of social and political policies on crime rates. Political parties are naturally hesitant to admit that their social, political and economic policies may be criminogenic. Criminal justice system explanations of crime may thus have been politically misused to ignore national inequalities or realities. In a study conducted in the United States of America researchers found that ‘[t]he standard politician’s explanations of crime (insufficient police, lax penalties, and too few prisons) were noticeably absent from ... [the public’s] conception of the causes of crime’ (Campbell & Muncer 1990:417).

In the previous section responses to crime in South Africa were discussed. Presently the emphasis is on opportunity-reduction approaches to crime. Within these approaches, the social-problems approaches have been neglected. In terms of the social-problems approach, social problems such as unemployment, racial misunderstanding, youth and others²¹ which may be criminogenic are addressed in order to prevent crime. In terms of the social-problems approaches to crime the argument is that crime is 'poverty-induced', as opposed to 'prosperity-induced'. Wong (1995:237) is of the opinion that the distinction between 'prosperity-induced' and 'poverty-induced' crime must be clearly understood; the former is associated with the 'pull' factors related to prosperity and the latter to the 'push' factors related to poverty. In economic terms 'prosperity-induced' crime is related to the gains associated with crime and hence the returns to illegitimate activity, whereas 'poverty-induced' crime is related to the deprivation associated with legitimate activities and hence the returns to legitimate activity. Policies aimed at increasing the returns to legitimate activity by alleviating social problems, using agencies other than the criminal justice system to assist in crime prevention, are presently ignored to a large extent. The social-problems approaches to crime prevention have tended to be ignored by communities and the government thusfar, probably owing to the fact that when social problems are alleviated, not only is crime prevented, but the standard of living of citizens who would never have contemplated crime is also improved.

'Community action can be remarkably effective, but crime is a national problem that needs the national action and funding that only the government can provide' (Barker 1995:39). 'All other institutions of civil society can and should assist, but only the government can do it' (Nedcor 1996:16). Given that the government's role in coordinating crime prevention policy is the most crucial element for success, this study will focus on the activities of various government agencies regarding their potential for preventing crime.

The National Crime Prevention Strategy states that '[n]ot only the core "criminal justice" departments of state need to deal with crime ... Unlike crime prevention efforts in the past, all departments now need to work in a concerted and coordinated manner' (Nedcor 1996:19). To date this has not been achieved. The Nedcor Project investigated the extent

to which other central government departments had included crime prevention activities in their departmental planning. They found that while some core departments had not considered crime prevention, some seemingly peripheral departments had produced meaningful strategies (Nedcor 1996:22). It can therefore be concluded that no attempt has been made to compel all the government agencies to consider the various crime prevention strategies which they could employ. Further it can be concluded that there has been no concerted attempt to adopt a multi-agency approach to crime in South Africa, let alone a social-problems approach. This being the case, obviously no assessment has been made of the relative impact of all crime prevention strategies in order to ensure that only the most effective strategies are ultimately implemented and that ad hoc measures are avoided.

From the above it is clear that the reliance on the efforts of the criminal justice system and its opportunity-reduction approaches to crime has not and will not suffice. As noted above the focus in this study will be on various government agencies, more specifically to ascertain the effectiveness of various government policies, including law enforcement policies, in crime prevention. This has been largely neglected in the public debate on crime prevention. The main aim of this study is to determine the type of public expenditure required in the prevention of crime in South Africa, particularly whether the continued increase in expenditure on the criminal justice system exclusively is effective. Although a social-problems approach will be adopted, the objective in this study is not to evaluate any specific theory or social programme systematically but rather to determine whether several measures commonly associated with theory and social programmes have expected effects on crime rates.

It cannot be denied that reliance on the efforts of the criminal justice system is necessary, if not sufficient, for preventing crime effectively in a society based on the rule of law. Therefore Section 1.3 was devoted to a detailed assessment of the performance of the South African criminal justice system. In order to comprehensively research effective crime prevention, not only must the effectiveness of the criminal justice system and government spending in other areas be analyzed in detail, but the efficiency of the criminal justice system must also be considered. An additional aim of this study is to ascertain the relative

importance of resource inputs in the departments of the criminal justice system. '[O]nly when the relationship between agency output and input are (sic) observed and determined can ... [departments] hope to make improved resource allocation and budgeting decisions' (Chapman et al. 1975:197).

The academic merit of this study lies in the fact that the economics of crime prevention policy, including an assessment of the performance of the criminal justice system, has never been formally researched in South Africa and thus the relevant issues will be addressed for the first time. Even worldwide not much research on this topic has been conducted. The application of the economic approach to crime prevention is, therefore, a relatively unusual economic study. But in this study the analysis is broadened further, in the development of an interdisciplinary theory of crime causation. This approach is more refined and academically sound as it is scientifically based and yet allows for the assessment of competing theories in practical terms for the South African situation. It is believed that this study of crime in South Africa will provide new insights into policy decision-making, which has up to the present been based on ad hoc methods. This will ensure that the study is, not only one of academic merit, but also one of practical value. In the course of this research many issues that merit further scientific investigation will be raised for the first time.

1.5 THE METHODOLOGY AND HYPOTHESES OF THIS STUDY

The main focus of the conventional economic theory of crime has been on the influence of law enforcement variables on crime, although the economic model of the market for offences also suggests the importance of other variables. The primary aim of this study is to assess the significance of a wider variety of types of public expenditure in preventing crime effectively, in addition to assessing law enforcement expenditure. In order to gain a greater understanding of the causes of crime, various theories of crime will be considered in order to determine some of the possible causes of the high crime rate in South Africa. In this thesis the framework for analysis is the economic model of the market for offences, which has classical foundations. But the analysis is broader than the traditional neoclassical approach in that it considers not only law enforcement variables, but also socio-economic and economic variables as policy instruments capable of influencing crime in society. Thus

an interdisciplinary theory of crime will be developed, which considers economic, sociological and political theories of crime causation. Once this framework has been developed, it will be possible to predict the impact of changes in the different variables on the crime rate in South Africa.

The variables that appear to be important in influencing the crime rate in simple, descriptive analysis will then be tested empirically in order to establish their significance in reducing the crime rate in South Africa. In this way the relative importance of the various law enforcement, economic and socio-economic variables in determining the crime rate will be ascertained. As most of the theories of crime causation will be tested for the first time within a South African context, empirical evidence will enable the researcher to identify the most dominant influences from what otherwise is merely a collection of beliefs about crime causation.

Variables that are identified as being significant in determining the crime rate have the ability to prevent crime. The major focus of this study, however, is on determining the types of public expenditure that are effective in providing a reduction in crime. By identifying those significant variables which have clear and desirable public policy applications and considering their contribution, it will be possible to make policy recommendations concerning the public programmes that should be used to reduce South African crime.

The central hypothesis that will be assessed in this study is that more public expenditure exclusively on the criminal justice system in order to prevent crime in South Africa is not most effective. It is contended that crime prevention policy would be more effective if use was also made of the types of public expenditure that relate to the significant economic and socio-economic variables influencing crime. Even if it is not possible to establish the dominance of any particular economic or socio-economic variable or group of variables in influencing the crime rate, the hypothesis will be verified if it is possible to establish that law enforcement variables do not dominate in their ability to prevent crime effectively. The crucial question which must be answered in this study is whether public expenditure on other government agencies has significant crime reduction effects. The crime reduction

effect of expenditure on the criminal justice system must also be assessed. If law enforcement variables prove not to be the only significant variables in determining the crime rate in South Africa, an argument would essentially be provided for shifting expenditure to some extent from the criminal justice system to other government agencies capable of influencing significant crime-reducing variables. That is, traditional opportunity-reduction approaches to crime are necessarily to some extent replaced with social-problems approaches.

Law enforcement variables offer the most direct policy instruments for attacking crime. Therefore, the secondary aim of this study is to evaluate the efficiency of the resource inputs in the departments comprising the criminal justice system. Production functions for departments in the criminal justice system will be estimated, linking the output of a department (law enforcement variable) to the numerous departmental resource inputs. The relationship between crime and the output of the departments of Safety and Security and Justice will have been determined in the previous analysis. It will, therefore, be possible to consider the relationship between a particular resource input in any one of the two departments and crime. In this way effective resources that should be used in the prevention of crime will be identified and policy recommendations will be made on this basis.

In recent years in the departments comprising the criminal justice system an overwhelming percentage of total annual expenditure has been devoted to personnel and this has grown, at the expense of expenditure on other resources. The secondary hypothesis of this study is that more expenditure on personnel in the departments of the criminal justice system is not most effective in South African crime prevention. In this regard the question which must be answered in this study is how the crime reduction effects of the various categories of non-personnel expenditure in the criminal justice system compare to those of expenditure on personnel. The hypothesis will be verified if it can be shown that personnel expenditure is not the most important determinant of the departments' law enforcement output. If this is ultimately the empirical result, a case will be made for shifting expenditure from personnel within these departments, toward non-personnel resources to some degree.

1.6 SOUTH AFRICAN LITERATURE CONCERNING CRIME

In line with the aims of this study, South African and international literature was consulted in search of theories of crime causation and empirical studies of the variables that are thought to influence crime and of production functions relating to the criminal justice system. Regarding the South African literature specifically, there has been a fair amount of research concerning crime. Most of this work can be categorised in terms of the following areas: the law (which is the focus of studies conducted by legal experts), the operation of the criminal justice system in its entirety (Barker 1995, Nedcor 1996, South Africa Foundation 1996) or the efficiency of specific components, such as policing (Hirschowitz et al. 1998, Nedcor 1996, South Africa Foundation 1996, Taytasac 1988), justice (Nedcor 1996, South Africa Foundation 1996) or prisons and punishment (Labuschagne 1975, Nedcor 1996, South Africa Foundation 1996), crime statistics regarding the rate of crime and its trend (Barker 1995, Glanz 1994, Nedcor 1996, Shaw & Gastrow 2001, South Africa Foundation 1996), crime prevention policy (Nedcor 1996, Shaw & Gastrow 2001), demographic analyses (Labuschagne 1975, Nedcor 1996, Shaw & Gastrow 2001, South Africa Foundation 1996), victimization studies (Glanz 1994a, Hirschowitz et al. 1998, Nedcor 1996, Schurink & Strijdom 1976, South African Labour and Development Research Unit 1994), studies on the public perception of crime (Barker 1995, Glanz 1994a, Nedcor 1996, South African Labour and Development Research Unit 1994) and the public reaction to crime (Glanz 1994a, Nedcor 1996, Shaw & Gastrow 2001, South Africa Foundation 1996), the cost of crime to South Africa (Nedcor 1996, South Africa Foundation 1996), the sociological theories of crime (Labuschagne 1975, Schurink & Strijdom 1976) and empirical assessment of the determinants of crime (Luiz 2000).

Thus, there is extensive research on crime. However, hardly any of it is relevant to the issues being addressed in this work. From the above list, the South African research concerning the sociological theories of crime is relevant to this thesis. Not a great many of these studies have been conducted and the subculture theories of crime have received the most attention. The reason for their inclusion in this study is, however, not to evaluate any specific theory of crime systematically but to identify variables which are important in determining crime. The only other South African research that falls within the ambit of this

study is the empirical analysis of crime determinants. Luiz (2000) is the only South African researcher who has adopted the economic approach²² when considering the crime problem. He considered the influence of income per capita, police officers per capita, conviction rates and political instability on the per capita levels of various South African crimes between 1960 and 1993. However, in South Africa no extensive aggregate level empirical research has focussed on identifying the numerous variables that are significant in influencing the crime rate or considering the effectiveness of using various types of government expenditures as policy instruments in crime prevention, let alone on the efficiency of using various types of criminal justice system resource inputs.

1.7 RATIONALE FOR CONSIDERING PROPERTY AND VIOLENT CRIMES AS SEPARATE CATEGORIES

The focus of this study is on the prevention of overall crime in South Africa. In addition property and violent crime will be analyzed independently as South Africans are particularly concerned about these crime categories. Property crime is defined in Class D of the South African Police Service's Standard Code List of Offences and includes all crimes which involve the taking or destruction of property belonging to another person without their permission. The property crimes that will be considered in this study are: robbery with aggravated circumstances (with firearms), robbery with aggravated circumstances (without firearms), other robberies, burglary of business premises, burglary of residential premises, stock theft, shoplifting, theft of motor vehicles and motorcycles, theft from motor vehicles, other thefts, arson, malicious damage to property and all fraud, malappropriations, embezzlements *et cetera*.²³

The violent crimes included in this study are: murder, attempted murder, robbery with aggravated circumstances (with firearms), robbery with aggravated circumstances (without firearms), other robberies, rape of children (0 - 17 years), rape of adults, assault with the intent to inflict grievous bodily harm and common assault. The South African Police Service does not have a violent crime class in its Standard Code List of Offences but their National Crime Information Management Centre (Warrant Officer H.A. Bester, pers. comm. 29 November 1995) confirmed that the above crimes constitute violent crime in South Africa

as they involve a threat to the life and body of a person. Crimes relating to undermining the authority of the government, disruption of the order in society, prostitution and road traffic will not be considered at all in this study.

Presently South African citizens are extremely concerned about the wave of violent crime that continues to sweep the country. 'South Africa has a "violence index" of at least 500% above the international average of countries which provide reasonably reliable data, making it the most criminally violent country on earth' (Nedcor 1996:70). In Table 1.3 on page 6 it was noted that the rates of murder, rape, robbery and assault in South Africa are all amongst the highest internationally. The astronomical rates of growth of violent crimes are a relatively recent phenomenon. The South African Police Service is, however, of the opinion that the actual number of violent crimes has indeed increased and that the increase is not a result of increased policing of violent crimes in South Africa (South African Police Service, pers. comm. 25 October 1995). South Africans appear to be unable to resolve disputes without resorting to disruption and violence (South Africa Foundation 1996:36).

In the mid 1990s crime researchers correctly pointed out that violent crimes were increasing faster than other crimes in South Africa (Glanz 1994, Nedcor 1996:14). Even then it was apparent from the statistics that property crimes were increasing faster than other non-violent crimes and that there were on average more incidents of property crimes per 100 000 of the population than other crimes, including violent crimes. From Table 1.1 on page 4, which considers crime rates per 100 000 citizens, it is evident that since 1994 the overall crime rate increased by 24 percent. During the same period the property crime rate increased by 36 percent, while the violent crime rate only increased by 13 percent. Not only are property crimes increasing faster than any other crime category currently, the fluctuations in property crime rates are occurring on a high plateau. In 1999 burglary (residential and business) alone accounted for 15.75 percent of all reported crime. Over the long-term (1975 - 1994) property crimes also increased faster than violent crimes (South Africa Foundation 1996:30-31). It was noted in Section 1.2 that the property crime rate in South Africa is extraordinarily high for a developing country.

The significant impact that property and violent crimes have on society is evident from the results of South African victimization studies. In a victimization survey conducted during 1991 it was determined that 25 percent of all respondents had been victimized, 20 percent had suffered property crimes and 9 percent violent crimes (Glanz 1994a:14). Although Black and Coloured people were victims of property crimes to a lesser extent, 62 percent of Black and 61 percent of Coloured victims experienced property crimes (Glanz 1994a:41). The most recent national victimization study found that 21 percent of all households experienced crime in 1997, property crime was still the most predominant crime category, accounting for 83 percent of household crime (Hirschowitz et al. 1998:iii).

Critics of the economic approach to crime often contend that the economic model is only applicable to crimes which have inherent economic qualities, like property crimes.²⁴ The economic model is believed to be limited in its ability to explain crimes of abuse and violence, crimes political in nature and crimes related to dependence-producing substances. For each of these crimes, the assumption of economic theory that the criminal behaves in a rational manner is questioned. And in the case of crimes relating to dependence-producing substances, an additional consideration is the morality of the law. That is, the consensus approach to defining criminal behaviour is questioned as it may be that these activities are defined as criminal only to establish the morals and power of the ruling groups in society.

In this study driving under the influence of alcohol or drugs and drug-related crimes are included in the total crime statistics, however, it is unlikely that they will have a significant effect on the results of the empirical analyses as they comprise a very small proportion of overall crime. Therefore in this regard the difficult theoretical questions concerning the rationality of the criminal and the morality of the law are avoided. Violent crimes will be analyzed as a separate category and for this category the assumption of rationality is questionable. It will therefore be necessary to examine the empirical results of this research in Chapters Three and Four, to check if the crime causation variables which are significant in determining violent crimes are different to those which determine the other crimes considered. If this is the case, the relevance of using the economic approach to analyze

these crimes can be challenged as it will be evident that the element of violence in these crimes substantially changes the nature of the crime.

1.8 CONCLUSION

In the beginning of the chapter the crime problem in South Africa was considered. It was determined that by international standards South Africa has exceptionally high crime rates, especially when regarding violent crimes and property crimes. The macro and microeconomic effects of crime are not trivial; and place a high monetary cost on South Africans every year. The criminal justice system was analyzed in terms of its ability to prevent crime. It was noted that there are many criticisms regarding each of the departments constituting the criminal justice system. These criticisms relate to efficiency and fairness in operations and the coordination of activities with those of other departments. Community assistance in crime prevention was also considered. It was concluded that the South African criminal justice system, with or without the efforts of the community, does not appear to be able to control crime.

The main aim of this study is therefore to determine the types of public expenditure that will be effective in crime prevention. In order to achieve this an interdisciplinary approach to crime causation will be adopted, including sociological, economic and political theories. The contribution of the interdisciplinary approach should not be underestimated. The interdisciplinary theory of crime developed will provide a consistent and integrated framework for a shift in the crime debate, which is urgently needed to address South Africa's crime problem. The current public debate about appropriate crime prevention policy in South Africa predominantly concerns necessary improvements in the criminal justice system. It is obvious that this narrow focus on criminal justice system reform is inappropriate in South Africa, and worldwide. It is, however, directly related to the traditionally narrow focus of the economic theory of crime on law enforcement variables, which inevitably lent itself to the exclusive use of the criminal justice system in crime prevention. General public opinion surveys indicate that it is widely believed that crime is a more complex issue, a shift in the public and academic debate, nationally and internationally, is therefore long overdue.

In order to identify the types of public expenditure that should be used in the prevention of crime, empirical research will be conducted and the significant variables determining the crime rate will be targeted for manipulation. The suitability of various public policies considered will then determine the types of public expenditure that should be used in South African crime prevention. Essentially changes in the activities of all government agencies, not just the criminal justice system, can be considered when applying an interdisciplinary theory of crime causation. In terms of the central hypothesis of this study it is contended that it will be more effective in South Africa to include the types of public expenditure that relate to the direct causes of crime, as the marginal impact of increased expenditure on the criminal justice system may be small.

Crime prevention policy will, however, always include criminal justice system activities and therefore it is essential that expenditure within the system is efficient. The secondary hypothesis of this study contends that South African crime prevention policy will be more effective if additional criminal justice system expenditure is focused on the most productive resource inputs, that is non-personnel inputs. In order to empirically assess this a production function analysis will be conducted for criminal justice system departments, to determine the contribution of various resource inputs towards departmental output.

In this study only property and violent crimes are considered as separate crime categories. It was argued that this is justifiable as property crimes are the predominant crime category in South Africa and are currently increasing faster than any other crime category, and violent crimes are high by international standards and growing. In the case of violent crimes the theoretical issues concerning the irrationality of the criminal cannot be ignored and the empirical results in this study will need to be interpreted with caution. It should be noted that in South Africa no expansive study has empirically considered the significant causes of crime, let alone the types of public expenditure that will be effective in crime prevention. Nor has any other South African researcher focused on the effectiveness of the various resource inputs in the criminal justice system.

NOTES:

1. The current crime data base was new and incomplete in 1994, hence information was only available for 33 categories of crime. Since 1995 information is obtainable for 37 crime categories. The additional categories appear last in the list below. The categories of crime used were: murder, attempted murder, culpable homicide, robbery with aggravated circumstances (with firearms), robbery with aggravated circumstances (without firearms), other robberies, illegal strikes, public violence, rape of children (0 - 17 years), rape of adults, statutory rape, indecent assault, crimen injuria, cruelty towards children, kidnapping of children, kidnapping of adults, abduction, assault with the intent to inflict grievous bodily harm, common assault, burglary of business premises, burglary of residential premises, stock theft, shoplifting, theft of motor vehicles and motorcycles, theft from motor vehicles, other thefts, arson, malicious damage to property, all fraud, malappropriations, embezzlements *et cetera*, driving under the influence, drug-related crime, illegal possession of firearms, illegal possession/use of explosives, car jacking, truck hijacking, cash-in-transit robbery and bank robbery.
2. In the report prepared by Nedcor (1996:4), changes in the level of various crimes over the period of 1990 to 1995 were considered. The only exception to the South Africa Foundation findings is the conclusion that the number of murders decreased over the period. This does not imply a contradiction as the South Africa Foundation considered a longer period, including 1988 and 1989. The most recent South African crime information clearly indicates that murder is the only crime for which there has been an absolute decrease in the number of incidences.
3. These figures were arrived at by compounding the increases in crime given for the individual periods 1988 to 1992 and 1992 to 1994.
4. However, according to the Nedcor report (1996:57), '[s]ince the General Election of April 1994 foreign investment has entered the country on an increasing scale. ... This

has been accompanied by a 51% increase in foreign visitors (businesspeople and tourists)'. This apparent contradiction is easily resolved when considering that the increase in foreign investment and visits may have been greater, had the level of crime been lower.

5. 'Economic growth, in turn, is one of the preconditions for the reduction in the *causes* of crime and violence [my italic]' (Nedcor 1996:61). Economic growth as a contributing factor in crime prevention will be considered in Chapters Three and Four of this study. In the empirical analyses the income variable poverty-gap index (poor) will be used as the measure of economic well-being.
6. Economic inequality is generally believed to result in criminal activity as a means of survival for poor people. However, it is also true that most 'victims are African and poor. This conclusion is based on a measure of the proportion of each socioeconomic and race category victimized' (Shaw & Gastrow 2001:243). The majority of victims are least able to afford protection and insurance against crime. Although the poor are victims of property crimes to a lesser extent (and violent crimes to a greater extent), they are more likely to lose a greater proportion of their total assets to crime than wealthy people, who also have financial assets (South Africa Foundation 1996:35). It is also noteworthy that the poor have less access to public policing. Poverty is therefore criminogenic as it, not only provides a motive for criminal activity, but also provides an environment conducive to such activity.
7. For a more rigorous and mathematical exposition of the costs of crime, particularly regarding their changes in response to variations in the probability and size of punishment, Becker (1976), Ehrlich (1981) and Sedgwick (1984) can be consulted.
8. There is some controversy surrounding the approach to the calculation of society's damage costs. According to Becker, some of the losses to the victim are received as benefits by the criminal and in these instances he asserts that society's welfare has not been negatively affected. These costs to the victim can be excluded from the

overall damage cost. Sedgewick (1984:48) disagrees, '[s]ociety has experienced a net loss since scarce resources were used not in production but in making a transfer.' He argues that if the "theft industry" is competitive (a possibility conceded by Becker), the cost to the criminal of committing the crime is exactly equal on the margin to the market value of the stolen goods. Thus the criminal breaks even and is just compensated for undertaking crime, therefore the criminal does not experience any economic profit relating to such transfers. A net loss to society remains which is equal to the total loss of wealth of the victim. Accordingly, all costs to the victim should be included in the overall damage cost. Sedgewick is rightly of the opinion that this alternative approach is preferable. Firstly, it accords with correct economic theory and secondly, as the criminal's gain is illegally obtained, it could be argued on moral grounds that it cannot be compared to the hard-earned gains of other individuals in society. For the purposes of this study, this principle has been extended to apply to the calculation of all the categories of economic costs of crime, not only to damage costs in particular. That is in all calculations the costs to criminals of committing crime will be ignored.

9. In terms of Becker's approach (1976) the total cost of punishment to a society is made up of two parts: the costs of punishment borne by criminals and any additional costs of implementing punishment to the rest of society. Essentially the two approaches amount to the same figure, although the emphasis on where the incidence of the cost lies differs.
10. The South Africa Foundation (1996:33-34) emphasises that lower foreign direct investment, lower tourism revenues, increased emigration and lower domestic investment are important macroeconomic cost considerations that are normally excluded in economic analyses of the costs of crime. Although not directly quantifiable, they must be acknowledged as damage costs of crime to society. With respect to the costs of apprehension and conviction and punishment costs, Sedgewick (1984) points out that there are additional costs associated with wrongful conviction and punishment that should also be considered. It should also be noted

that besides the expenditure on the criminal justice system itself, the presence of crime also necessitates additional expenditure in the departments of Defence, Welfare and Health.

11. 'In many areas the true picture is even worse, since the police are distributed unevenly across the country, and across cities' (South Africa Foundation 1996:38). The extent of the problem is highlighted in this one example - '[i]t is reported that only 6 of the 59 vehicles of the Johannesburg flying squad are operational at any one time, because of staff constraints' (South Africa Foundation 1996:37 fn20).
12. The low morale in the police force is largely due to the perception that police officers earn low salaries, given the tasks that they are required to perform. This perception has remained, despite the substantial salary increases received in 1996 (Nedcor 1996:76). In every year subsequently the average salary of police officers has increased in real terms. Another factor contributing to low morale is that the rights of criminals have been entrenched in terms of the new South African Constitution. In the National Crime Prevention Strategy 'specific mention is made not only of the rights of the suspect and the accused, but also of the prisoner ... However, the document is less explicit on the predominant right of the law-abiding citizen to be protected from crime' (Nedcor 1996:19).
13. In a South African survey nearly 60 percent of the respondents were of the opinion that the introduction of a 'bobby on the beat' system and quicker reactions to resident's requests for help are effective crime-combatting strategies (Glanz 1994a:60). Four years later in a Reader's Digest study (Barker 1995:37) more than 80 percent of the respondents indicated that police should walk their beats.
14. Given the high unemployment rate in South Africa, organised labour is bound to oppose this. Obviously the impact of prison labour on free labour is an important consideration in this regard.

15. Racial discrimination is, however, not only particular to South Africa, 'Pope and Feyerherm recently reviewed over three decades of research ... Approximately two-thirds of the literature reviewed found disproportionate treatment of minorities even after relevant variables were statistically controlled. These disproportionate results were not limited to any one decision point, but were manifested across various stages of juvenile processing (e.g. intake, detention, adjudication, disposition)' (Pope 1993:169). Although allegations of racial discrimination in South Africa's past cannot be denied, it is also true that, in a society where race and class are closely related, it is difficult to distinguish between discrimination and discretion in crime prevention. Criminals from a middle-class background are more likely to convince law enforcement authorities that they will refrain from criminal activity in future than poor criminals are.
16. Whereas individual responses refer to activities undertaken unilaterally, community responses refer to activities undertaken in cooperation with others. The term community should be interpreted in the widest possible sense as an all encompassing definition of participants. Included are the responses to crime of business, civic organisations, non-governmental organisations, local authorities and the like.
17. It is important to note that the concept of avoidance behaviour used by Glanz and in the Nedcor report, referred to in the previous section of this chapter, is broader and includes "target hardening", which Fisher considers as a separate category.
18. For a more detailed discussion of community responses to crime refer to Fisher (1993). Refer to Barker (1995), Business Against Crime (1997), Nedcor (1996), South Africa Foundation (1996) and Taytasac (1988) for information that is specific to South Africa.
19. The efficiency of all other government agencies is also taken as given. It is, however, acknowledged that '[t]he current **process of transforming the state** is part of the

solution to crime. Its success will depend on the extent of the transformation, and on the extent to which structures are created which have legitimacy and authority' (South Africa Foundation 1996:36).

20. In South Africa it is unclear to what extent academic literature has been considered in government policy-making but it certainly does not appear to have had a significant impact on policies. In 1996 the government consulted academics to assist in the formulation of the National Crime Prevention Strategy but the significance of this in terms of the crime prevention policies finally implemented is questionable, as academics have not been included in the process of applying the guidelines for implementation. Sedgwick (1984:116) points out that since 1968 in the United States, 'in general, it can be said that the academic literature has had a decreasing impact on government planning for law enforcement'.
21. The social-problems approach does not only relate to social problems in terms of a narrow definition, but is a broad term used to refer to problems which can be more specifically defined as social, economic or political.
22. It must be remembered that the economic approach referred to is not the Neoclassical approach. In this instance the framework of analysis is the economic model but the economic approach essentially embodies an interdisciplinary theory of crime. As can be seen from the summary of South African research, the South Africa Foundation and Nedcor studies are the most recent expansive analyses of crime in South Africa. The Nedcor study deserves particular mention for its unique contribution because of: the original research undertaken, the innovative interpretation of existing information and its business focus. Yet although the South Africa Foundation (1996:29-40) and the Nedcor Project (Nedcor 1996:11-13) both identified numerous variables which are important in determining crime in South Africa, they did not link these variables theoretically using the economic approach.

23. The only subclass of property crimes defined in the South African Police Service's Standard Code List of Offences that will not be considered is the preservation of plants, animals, the environment and inanimate objects.
24. Even Sedgwick, who believes that the economic model of crime is the best theoretical framework currently available, does not believe that the economic model is comprehensive enough to analyze all types of crime. His reasoning is given in footnote one in Chapter Two on page 78.

CHAPTER TWO

TOWARDS AN INTERDISCIPLINARY THEORY OF CRIME CAUSATION

2.1 INTRODUCTION

In Chapter One it was noted that the main aim of this study is to determine the types of public expenditure that constitute effective crime prevention policy in South Africa. Presently the exclusive focus on increases in expenditure on the criminal justice system does not appear to be sufficient, not only is the crime rate high, it is also increasing rapidly. However, before public expenditure policy can be evaluated it is necessary to address the issue of crime causation in South Africa. Therefore an interdisciplinary approach to the theory of crime causation must be adopted in order to provide additional perspectives, which are broader than law enforcement.

To accomplish this in the chapter firstly, a framework of analysis will be selected within which to develop an interdisciplinary theory of crime causation. Secondly, the conventional economic theory of crime and its implications for crime prevention policy will be considered. Thereafter, the rationale for using a broader interdisciplinary theory will be provided. Finally, an interdisciplinary theory of crime will be proposed and its crime prevention policy implications will be examined.

2.2 A PARADIGM FOR AN INTERDISCIPLINARY THEORY OF CRIME CAUSATION

Worldwide the overwhelming majority of countries, including South Africa, rely largely on the criminal justice system for crime prevention. Therefore in order to conduct any study concerning crime, a systematic approach is needed which is able to weigh all the influences of the criminal justice system on the crime rate in South Africa. From the discussion in Chapter One on pages 15 to 30 regarding the complexities involved in the operations of the various departments of the criminal justice system and the extent to which departments influence each other, it is obvious that this is not an easy task. In terms of the multi disciplinary perspective which is taken in this study, the approach adopted must also be able to include all additional influences on the crime rate over and above those related to the operations of the criminal justice system. The economic model of the market for

offences is such an approach and is, in fact, the relevant paradigm that will be used in this study to introduce focus and order when developing an interdisciplinary theory of crime causation.

The choice of a framework for analysis is critical to the success of crime prevention policy formulation as different frameworks yield different policy proposals. The economic model of the market for offences is arguably the most comprehensive framework currently available (Sedgwick 1984) and the non-economic theories and variables that will be considered in this research can all be incorporated into this paradigm. Opp (1989:406) is also of this opinion as he contends that: 'a common misunderstanding amongst sociologists is that the economic theory of crime is [only] concerned with the influence of economic factors on crime.' He argues that the application of the economic approach to sociological theory, which he believes is often implicit, conditionalises the sociological hypothesis making it precise and empirically testable. According to Sedgwick (1984) the economic approach has a theoretical advantage over any other approach as it allows for successful crime prevention policy, that is in a practical sense.¹

2.3 THE CONVENTIONAL ECONOMIC THEORY OF CRIME

Crime and crime prevention are relatively new fields of research within economics, although the framework of analysis is conventional neoclassical theory and welfare economics. Its modern origin can be traced to the seminal work of Becker in 1968.² Essentially economists consider the theory of criminal activity as a variant of the microeconomic theory of occupational choice (Reynolds 1980:27-69). The assumptions of the model are the following. Firstly, individuals have certain preferences regarding their choice of occupation. These are influenced by their predisposition to criminal activities or what is commonly referred to as their "morals". Secondly, individuals have a specific endowment of resources. The limit to their resources is a constraint on their occupational choice. Thirdly, it is assumed that individuals strive to maximize their well-being in their choice of occupation and therefore their choice is optimizing given the information that they possess. That is, it is assumed that the individual acts rationally³, even when choosing to pursue criminal activity - as this is the most profitable occupation for the individual. The implication of this

model is that criminal activity will be undertaken by an individual as long as the perceived profit from such activity exceeds that of other occupational activities. It is important to note that this model is capable of explaining, not only the choice to participate in criminal activity, but also the frequency of participation in such activity. It is possible for an individual to undertake any combination of illegitimate and legitimate activities.

In order to decide whether criminal activity will be the optimal occupational choice, a cost-benefit analysis is undertaken by the individual. The benefit of committing a property crime is easily calculated if it is assumed to be the market value of the goods taken, even if this does not correctly approximate the value to the criminal. In the case of crimes that inflict bodily harm on the victim, however, there is no easy calculation of the benefits that the criminal derives as they are essentially subjective and non-monetary in nature. Bowles (1982:55) suggests that these benefits can be gauged from either the amount of money that must be paid to persuade the criminal not to commit the crime, or from the effect that a change in the criminal's costs to committing the crime has on the occurrence of the crime.

The costs of criminal activity must also be considered. Firstly, there is a direct cost involved in committing a crime, which relates to the skills, equipment and contacts that must be acquired. Secondly, there is a punishment cost if the individual is caught. As there is also the possibility that the criminal will not be caught, this introduces uncertainty into the decision-making process. The expected punishment costs therefore depend, not only on the nature and size of the punishment, but also on the probability of being punished. It is assumed that the individual's personal perception of the expected punishment costs varies with changes in the probability of punishment and the size and nature of punishment. Thirdly, there is an opportunity cost to the individual when deciding to pursue criminal activity - the forgone net earnings from legitimate employment. The potential earnings from legitimate employment may approximate zero in countries which have high unemployment and underemployment levels. Traditionally economists do not consider the moral cost to the individual of committing the crime, although they do acknowledge its existence. The individual weighs up the costs and benefits of criminal activity and will commit crime as long

as the net benefit from such activity is positive, or the marginal benefit exceeds the marginal cost.

Traditionally economists have argued that in order to prevent crime the costs of criminal activity to the individual must be targeted for manipulation as the benefits of criminal activity are too obscure for this purpose. A decision had to be made regarding which of the costs is best suited for this purpose: the direct cost, punishment cost or opportunity cost. Increasing the direct cost of criminal activity is ultimately believed to constitute an unproductive use of economic resources as taxes imposed on the equipment used by criminals will most likely also have an impact on other consumers who use this equipment for legitimate purposes. Increasing the opportunity cost of criminal activity was typically believed to entail rehabilitation, which has not been very successful in preventing recidivism. As a result there was general consensus that the punishment cost should be targeted for manipulation; that is, deterrence was advocated (Becker 1976, Ehrlich 1981, Reynolds 1980&1990). In order to decrease the crime rate, the probability of punishment and/or the cost of the median sentence should be increased. The cost of the median sentence being a function of the nature and size of the punishment. Studies by Ehrlich and others (Becker 1976:53) indicated that individuals were more responsive to changes in the probability of punishment than to changes in the cost of the median sentence⁴ and because of such findings, it has been suggested that crime prevention strategies focus even more narrowly on increasing the probability of punishment.

*It happens, but crime is not
the same as deterrence*

For the purpose of this study, a distinction must be made between an individual level study and an aggregate level study of crime. The economic model of the market for offences can be used in an aggregate level study whereas the model of the individual's decision-making regarding participation in criminal activities can be used in an individual level study. As the focus of this study is on crime causation in South Africa, the economic theory of crime based on the model of the market for offences is the relevant perspective to be taken. Trumbull (1989:423-424) emphasizes that these two approaches, whilst obviously related, are not substitutes for each other as individual level studies focus on the determinants of criminality and the issue of specific deterrence, whereas aggregate level studies focus on

the determinants of crime and thus general deterrence. Individual level studies are most often recidivism studies aimed directly at reducing the criminal activity of existing or identified potential criminals. It should also be noted that Trumbull does not consider the results of recidivism studies to be as consistent as those of aggregate level studies as they generally use vastly different measures of variables and rely on limited official data. Importantly Ehrlich (1981) emphasized that even if success is achieved at the individual level and many criminals are rehabilitated, which is unlikely to be the case according to evidence, the supply of offences in the market may not decrease if new and existing criminals perpetrate more crime than before.

When considering the market for offences⁵, the supply of offences and the demand for offences must be regarded in turn. With respect to the supply of offences the focus is on the criminal behaviour of individuals in society. The supply of offences is a positive function of the return, or net benefit, from criminal activity. The higher the return from criminal activity, the greater the quantity of offences supplied. The net benefit from criminal activity was discussed above and is positively related to the benefit from criminal activities and negatively related to the direct cost, expected punishment cost and opportunity cost of criminal activities.⁶ In addition, the impact of the behaviour of potential victims on the return from criminal activity must be included. Potential victims may provide for their own protection and/or insure themselves against the effects of crime. As they purchase more protection it becomes increasingly difficult for the criminal to commit the offence because this results in an increase in the costs of committing crime and/or a reduction in the size of the taking. As potential victims purchase more insurance it becomes less costly for the criminal to commit the offence due to morally hazardous behaviour on the part of the insured. Ultimately the relationship between the return from criminal activity and the protection and insurance costs of potential victims depends on the relative size of the costs of protection and insurance. Generally, the market supply curve of offences reflects a positive relationship between the return from criminal activity and the number of offences.⁷

Formally the market supply function can be defined as follows:

$$S = s(r) = j(w_l, w_i, C) - pf \quad \text{where } w_l = b - dc \quad \text{and } S_r \geq 0 \quad (2.1)$$

where

- S is the supply of offences
- r is the return from criminal activity
- w_l is earnings from legitimate activities net of costs
- w_i is net earnings from illegitimate activities
- C is the cost of protection and insurance of potential victims
- p is the probability of punishment
- f is cost of the median sentence
- b is the benefit from illegitimate activities
- dc is the direct cost of illegitimate activities

The demand for offences must also be considered. When regarding the demand for offences the focus is on the behaviour of all individuals in society, particularly the extent to which such behaviour either encourages or discourages criminal activity. The demand for offences is implicit and is largely derived from the demand for safety. Increases in the return from criminal activity bring forth increases in the number of offences. This increases the demand for safety and conversely, reduces the demand for offences. Therefore the demand for offences is a negative function of the return from criminal activity. The demand for offences is made up of three components: the private demand, the public demand and the demand of the buyers of illegal goods and services. The private demand by potential victims for offences is derived from their demand for safety which indicates the extent to which they disallow criminal activity. As the number of offences increase, potential victims are more vulnerable to crime and therefore demand more safety and less crime. To this end they increase the amount of protection and insurance which they purchase and these costs increase. Ultimately when the return from criminal activity increases, the implicit private demand by potential victims for offences decreases as the costs of protection and insurance increase. The implicit public demand for offences is also negatively related to the return from criminal activity. As the return from criminal activity increases and therefore also the number of offences, the public will demand more safety. In response to this demand the state usually raises the expected punishment cost of committing crime, indicating the extent

to which criminal activity is disallowed, or conversely allowed. The demand of the buyers of illegal goods and services encourages criminal activity but displays diminishing returns as the number of offences increase. As there is a fixed stock of targets, when the number of offences increase, the costs to the criminal of committing crime increase and profitable crime opportunities become scarcer as the return from criminal activity decreases. The market demand curve for offences reflects a negative relationship between the return from criminal activity and the number of offences. Mathematically the market demand function can be represented as follows:

$$D = d(r) = h_1 + h_2 - pf \quad \text{where } h_2 = h(C) \quad \text{and } D_r \leq 0 \quad (2.2)$$

where

D is the demand for offences

r is the return from criminal activity

h_1 is the demand of the buyers of illegal goods and services

h_2 is the private demand by potential victims for offences

pf is the expected punishment cost of committing crime and

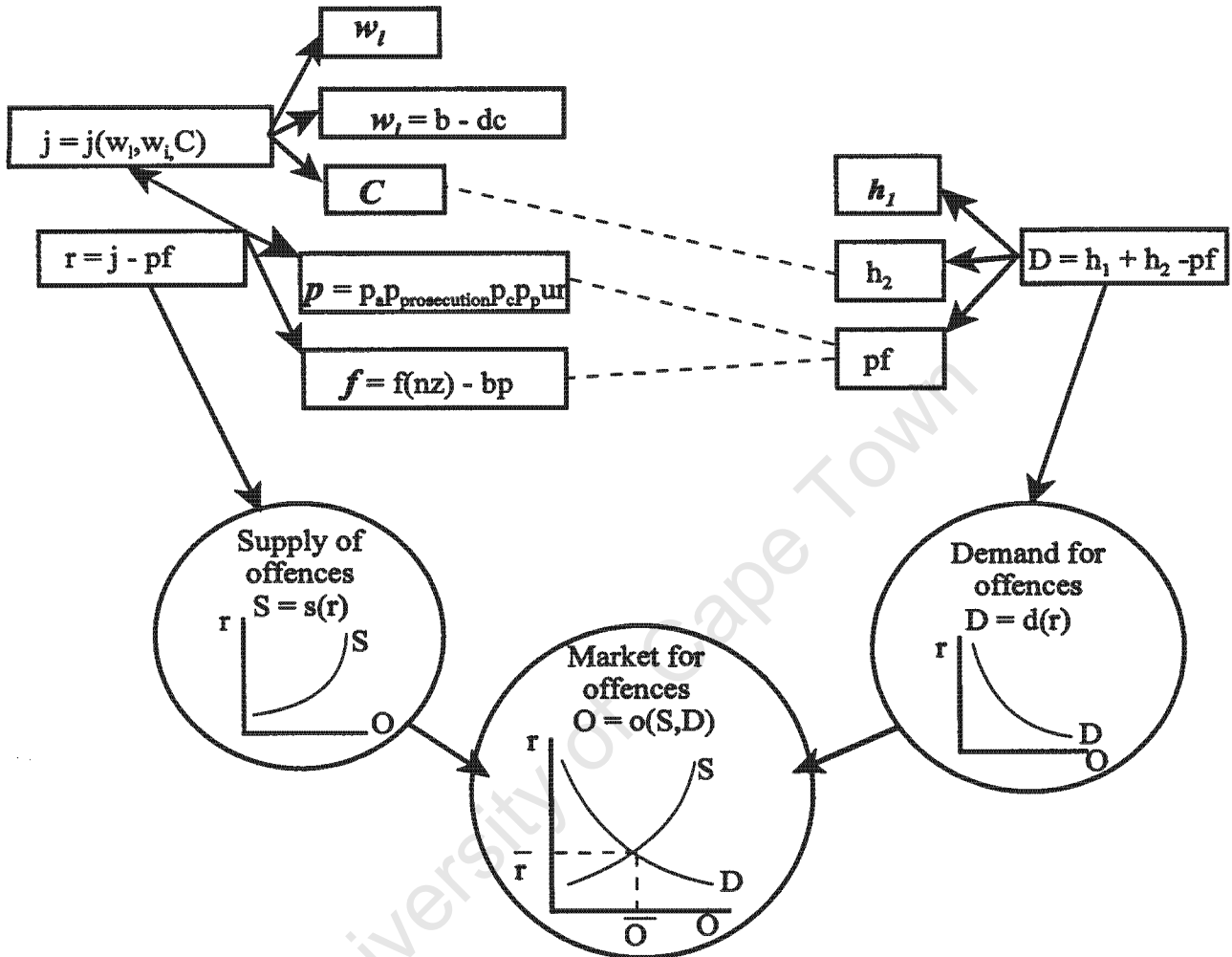
represents the public demand for offences

C is the cost of protection and insurance of potential victims

The neoclassical model of the market for offences can be illustrated as in Figure 2.1.

Figure 2.1: Diagrammatic Representation of the Traditional Neoclassical Model of Crime

$S = s(r)$ where $r = j - pf^a$ $j = j(w_l, w_l, C)$ $w_l = b - dc$
 $D = d(r)$ where $p = p_a p_{prosecution} p_c p_p ur$ $f = f(nz) - bp$ $S_r \geq 0$ O_p and $O_l < 0$
 $D = h_1 + h_2 - pf$ $h_2 = h(C)$ $h_{2c} < 0$ $D_r < 0$



where

S is the supply of offences
 r is the return from criminal activity
 p is the probability of punishment
 f is cost of the median sentence
 w_l is net earnings from illegitimate activities
 w_l is earnings from legitimate activities net of costs
 C is the cost of protection and insurance of potential victims
 b is the benefit from illegitimate activities
 dc is the direct cost of illegitimate activities
 p_a is the probability of arrest
 $p_{prosecution}$ is the probability of prosecution, given arrest
 p_c is the probability of conviction, given prosecution
 p_p is the probability of punishment, given conviction
 ur is an adjustment for unreported crimes
 n is the nature of the punishment
 z is the size of the punishment
 bp is the benefit of punishment (boarding and medical attention in prison)
 O is the number of offences
 D is the demand for offences
 h_1 is the demand of the buyers of illegal goods and services
 h_2 is the private demand by potential victims for offences
 pf is the expected punishment cost of committing crime and represents the public demand for offences

The equilibrium number of offences and the equilibrium return from criminal activity are determined where the supply of offences equals the demand for offences. The negative impact of crime on society is a direct function of the number of offences and it can be stated that:

$$O = o(S,D) \quad \text{and therefore} \quad O = o(w_1, w_2, C, p, f, h_1) \quad (2.3)$$

Accordingly an increase in the number of offences could be caused by any combination of the following: an increase in net earnings from illegitimate activities (w_1), a decrease in earnings from legitimate activities net of costs (w_2), a decrease in the cost of protection and insurance of potential victims (C) (equivalent to an increase in the private demand by potential victims for offences (h_2)), a decrease in the probability of punishment (p), a decrease in the cost of the median sentence (f), an increase in the demand of the buyers of illegal goods and services (h_1).⁹

As stated above, in their theorizing and empirical work economists have concentrated on the influence that law enforcement variables, the probability of punishment and the cost of the median sentence, have on the number of offences and to a lesser extent on the influence of economic variables, such as median income and the unemployment rate. They advocated deterrence as the means of crime prevention, as is customary in the classical theories of crime¹⁰. In so doing, the economic theory of crime was severely limited in terms of its potential as a theory of crime causation. They focused almost exclusively on the expected punishment cost of committing a crime, and therefore the activities of the criminal justice system, as the determinant of the rate of crime. Effectively, the number of offences was considered only as a function of the probability of punishment and the cost of the median sentence, that is $O = o(p, f, u)$ where u is a portmanteau variable representing all other influences (Becker 1976:47). Accordingly in order to decrease the crime rate, the supply of and demand for offences should be decreased by increasing the probability of punishment and/or the cost of the median sentence. They believed that crime prevention using the criminal justice system will always be more efficient than crime prevention involving the manipulation of the other costs of criminal activity. This is because expenditure on the criminal justice system was understood to impact solely on the crime rate (as it was designed specifically for that purpose), whereas other types of public expenditure were

understood to impact crime indirectly (via their influence on other variables), effecting all individuals and not only potential criminals. Sedgwick (1984) pointed out that other types of public expenditure, therefore, should rather be manipulated for efficiency and political reasons.

2.4 THE CRIMINAL JUSTICE SYSTEM AND THE DETERRENCE OF CRIME

Throughout most of the twentieth century, our primary response to the problem of crime has been to expand police and court resources ... Crime has not gone away ... leaving society with the worst of both worlds: high crime rates and huge prison populations' (Forst 1993:3). Reynolds (1990:262) specifically considered the relationship between the crime rate and the expected punishment for all serious crimes from 1950 to 1988 and found that from 1974 onwards the negative relationship between these variables is not manifest. His findings indicate that the law enforcement activities of the criminal justice system are not effective in deterring crime.

In Chapter One in Section 1.3 it was noted that in South Africa there are many factors which hinder the efficient and effective enforcement of the law - these are found throughout the entire criminal justice system. The public debate concerning crime prevention in South Africa is fragmented but it has, therefore generally been focussed on efficiency improvements required in these departments. The Nedcor report (1996:76) concludes that 'the present criminal justice system is not functioning at a level where it constitutes a credible deterrent to criminals'. Therefore in South Africa it is possible to argue that the law enforcement activities of the criminal justice system are not deterring crime because the system is inefficient; and not because deterrence is inherently inappropriate as a crime prevention policy.

According to Morris (1993:309), '[t]he criminal justice system ... [will] have a deterrent effect on the commission of crime, but, and it is a massive "but", marginal changes in any of those [sub]systems will not have a measurable effect on crime rates'. Essentially he argues that law enforcement variables are less significant in influencing the crime rate than economic and socio-economic variables. This has obvious implications for the types of public

expenditure to be used in crime prevention and the relative proportion within which they should be applied.

It is evident that the traditional focus of the economic theory of crime on the operations of the criminal justice system is not only severely limiting in terms of crime causation theory, but also practically in terms of crime prevention policy. Nationally and internationally a shift in the public and academic debate concerning crime causation is essential if effective crime prevention policies are to be implemented. In order to include all the factors thought to be important influences on the crime rate, an integrated theory of crime causation must be considered. Essentially an interdisciplinary theory of crime must replace the *conventionally focussed* economic theory of crime, which is not sufficiently sophisticated to manage the present challenges of crime prevention policy. One of the main reasons that South African researchers have not been encouraged to consider an integrated theory of crime causation, is that the data available for empirical testing is severely limited. However, it is important to note that an interdisciplinary theory of crime provides a systematic framework for the debate on crime causation, even before empirical testing is conducted.

2.5 AN INTERDISCIPLINARY THEORY OF CRIME

Forst (1993:13) states clearly that the breadth and nature of the issues relating to crime require research 'that transcends narrow academic disciplines' and Opp (1989:405-406), a sociologist, argues for the integration of economic and sociological theories of crime. Neither of these authors, however, systematically attempt the task. The South Africa Foundation and Nedcor studies are two examples of recent South African research providing a broad analysis of crime in South Africa. Yet although the South Africa Foundation (1996:29-40) and the Nedcor Project (Nedcor 1996:11-13) both identify social and political, economic and law enforcement variables which are important in determining crime in South Africa, they do not link these variables in terms of an interdisciplinary theory of crime causation.

Formal theories regarding crime causation vary from emotional and behavioural characteristics in psychology, physiological characteristics in biology, environmental and

organisational and process variables in sociology, interpersonal and institutional power relations in politics to cost and benefit considerations in economics. In developing an interdisciplinary approach to the theory of crime causation in this study, theories and perspectives¹¹ from both sociology and political science will be included. Other social scientists, particularly sociologists, have been theorising about socially deviant characters for centuries. Sociological structure theories will be included in this discussion. But sociological process theories, which attempt to explain the process by which people become criminals, will be excluded as they depend on information concerning personal characteristics. More generally, physiological and psychological theories have to be excluded as there is no information on the relevant variables at an aggregate level. The study will necessarily be limited to the theories that lend themselves to manipulation for public policy-making purposes. Political theories, regarding the power relations and inequalities in society, will also be considered. Essentially the two categories of non-economic theories that are considered in this study are the sociological structure theories and radical criminology theories. The sociological structure theories considered are the ecological, anomie, subculture and opportunity theories of crime; whereas the instrumental Marxist, structural criminology and feminist theories of crime included are radical criminology theories.

These theories must be incorporated within an interdisciplinary theory of crime in order to emphasise the impact of important economic and socio-economic variables that have thus far been largely excluded by economists. This represents the unique contribution that these theories make to the debate on crime causation and the accompanying debate on appropriate crime prevention policy. In order to appreciate the value added to the theory of crime without being overwhelmed by the details relating to each of these theories, only the economic and socio-economic variables introduced in these theories will be discussed below. Appendix A on page 243 can be consulted for a brief explanation of each of the theories, which will provide a better understanding of why the specific variables feature so prominently in a particular theory.

A table summarising the following discussion, concerning each of the economic and socio-economic variables introduced when regarding the sociological structure theories and radical criminology theories, can be found on page 73. In Table 2.1, the variables are listed and the specific variables that are emphasized in terms of each theory are clearly shown. For each variable, an indication is given of its precise relationship with the crime rate as well as a brief explanation of why this relationship is thought to hold. These relationships between the various economic and socio-economic variables and the crime rate are now discussed in greater detail.

Reynolds (1980:35), an economist, typically did not stress the effect of net earnings from legitimate activities on the crime rate, however, he did mention in passing some of the factors that are generally believed to influence net earnings from legitimate activities in terms of the neoclassical theory of crime, they are: median income, the unemployment rate, education, age, race and gender. These variables gain greater prominence in the sociological and political theories as indicators of "socio-economic status" or "access to conventional opportunities" and must be considered in turn.

Median income is generally regarded as determining the benefit from pursuing legitimate activities. Therefore low levels of potential income are considered to lower the earnings from legitimate activities, causing the rate of crime to increase. In some theories however, like Durkheim's anomie theory and the radical criminology theories, median income is considered as an indicator of the size of the potential benefit from illegitimate activities, that is the potential takings. In this case, high levels of income raise the earnings from illegitimate activities and therefore the crime rate.

The unemployment rate is regarded as an indication of the probability of acquiring legitimate employment. The higher the unemployment rate, the lower the potential earnings from legitimate activities and therefore the higher the crime rate. In the case of business related crimes, stressed in radical criminology theories, the unemployment rate is believed to indicate the probability of access to businesses and therefore the probability of acquiring

benefits from business related illegitimate activities. The lower the unemployment rate, the higher the potential earnings from illegitimate activities and therefore the crime rate.

The level of education influences the earnings from legitimate activities to a greater extent than the earnings from illegitimate activities as the skills acquired are more suited to legitimate activities. Therefore lower levels of education will lower the earnings from legitimate activities relatively and therefore increase the crime rate. When considering business related crimes, the level of education is an indicator of the probability of access to businesses and therefore the probability of acquiring benefits from illegitimate activities. The higher the level of education, the higher the potential earnings from illegitimate activities and the higher the crime rate.

The influence of age on the earnings from legitimate activities is related to the level of job experience acquired. Generally the younger individuals are, the lower their earnings from legitimate activities and the higher the incidents of crime. In some theories, particularly in the subculture theories, young individuals are considered to attach a lower moral cost to committing crime owing to their lack of socialisation. The moral cost of committing crime will be discussed below but ultimately it is believed that the younger individuals are, the lower their moral cost of committing crime and therefore the higher the occurrence of crime.

Race is regarded as an indicator of restricted access to job opportunities or job discrimination. Typically it is believed that minority groups are discriminated against and therefore their potential earnings from legitimate activities are lower, fostering criminal activity. In theories of crime and delinquency the reference to minority groups relates to groups that are discriminated against by the economically and politically powerful groups in society. In the case of South Africa, historically the major population groups have been discriminated against and they should be considered when testing these theories.

The influence of gender on the earnings from legitimate activities is also related to job discrimination. Women are discriminated against in terms of restricted access to the job market and therefore their potential earnings from legitimate activities are lower, causing

an increase in criminal activity if there is no such discrimination, or less, in earnings from illegitimate activities. Other theorists argue that the emancipation of women has improved access to the job market and therefore that women have a greater opportunity to commit business related crimes. The greater the extent of emancipation of women, the higher their potential earnings from business related illegitimate activities and the higher the crime rate. Some of these theorists, for example Hagen, argue that this increased participation of women in the labour market results in crime committed by their daughters, owing to the lack of maternal supervision which lowers the direct cost of committing crime and the expected punishment cost. The greater the extent of emancipation of women, the higher their daughter's returns from criminal activities and the higher the crime rate. Yet other theorists adhere to the chivalry hypothesis and argue that women are treated more leniently by the criminal justice system and therefore face lower punishment costs when committing crime. This raises the return from criminal activity and hence the crime rate. In terms of the subculture and differential opportunity theories the assumption is made that for males the moral cost of committing crime is lower, as a result of the prestige and status only males can achieve through criminal activities. This is based on the sexist belief that males achieve success in terms of the activities that they perform, which in the case of crime are daring, whereas females achieve success in terms of the relationships that they have with members of the opposite sex. Essentially the lower moral cost of committing crime for males, fosters crime. It is evident that there is no clear opinion on the relationship between changing gender relations and crime.

The postulated effects of the economic variables: income, the unemployment rate, educational achievement, age, race and gender on crime have been considered. Although it is obvious from the discussion that any particular variable may effect the rate of crime in numerous and contradictory ways, it is important to emphasise the effect of these variables on the earnings from legitimate activities.

Formally the function describing the net earnings from legitimate activities can be defined as follows:

$$w_l = w(y, u, e, a, rc, g) \quad (2.4)$$

where w_l is net earnings from legitimate activities
 y is income
 u is the unemployment rate
 e is educational achievement
 a is age
 rc is race
 g is gender

Collectively the effect of these economic variables on the earnings from legitimate activities can be seen as a general indicator of "socio-economic status" or "access to conventional opportunities", which is often referred to in non-economic theories of crime. Essentially the lower the median income, the higher the unemployment rate, the lower the average educational achievement, the lower the median age, the greater the number of minority groups and the greater the number of women; the more restricted access to conventional opportunities is or the lower socio-economic status is, resulting in lower earnings from legitimate activities and therefore increased tendency to commit crime. It is also important to note that some theories, like Miller's subculture theory and the radical criminology theories, consider the extent of inequality displayed by the variables as opposed to the level of the variables when regarding their relevance in explaining crime. In theories which consider the extent of inequality, the impact of the variables on crime is very similar to that described above.

finally by introduced

Another factor that merits attention, as it is very important in political and sociological theories, is the moral cost of committing crime. This is related to social values and norms, individuals and groups in society with values and norms which condemn deviant behaviour experience a moral cost associated with guilt when pursuing crime. The moral cost of committing crime is an additional cost which decreases the net earnings from illegitimate activities and therefore makes criminal activity less appealing. However, the lower the moral

cost of crime, the greater the net earnings from illegitimate activities and therefore the rate of crime.

Traditionally economists have always considered preferences, including moral preferences, as given and therefore they have ignored the predisposition of individuals towards criminal activity which is reflected in the size of the moral cost which individuals attach to criminal activity.¹² Individuals and groups who attach a positive moral cost to participation in crime have a preference for legitimate activity. This additional cost to committing crime makes crime less attractive for them. Individuals and groups who are indifferent between criminal and other activities attach no moral cost to pursuing crime. Therefore social morals do not influence their participation in crime. Individuals and groups who have a preference for illegitimate activity attach a negative moral cost to crime. That is they are predisposed towards crime as they attach a social benefit to it, owing to the status they receive in sections of the community as a result of criminal pursuits. These pursuits necessarily oppose proper social norms and values and these individuals and groups choose crime even if it "does not pay". The net earnings from legitimate employment must exceed the net earnings from illegitimate employment by an amount greater than the social benefit derived from committing the crime, in order to persuade them not to undertake the criminal activity.

Many socio-economic variables which are identified in the sociological and political theories are believed to cause social disorganisation when they change the existing social structure, weakening social control and changing social values and norms and therefore ultimately resulting in a society that is more predisposed towards crime. Essentially these variables all lower the moral cost of committing crime and increase the net earnings from illegitimate activities, resulting in a higher crime rate. The effects of age and gender on the moral cost of crime have been discussed above. The greater the proportion of males and young people in the community, the greater the proportion of the population that attaches a lower moral cost to pursuing crime and therefore is encouraged to do so. In addition the following factors must also be considered as causes of a lower moral cost attached to committing crime: industrialisation, family instability, deviant subcultures, criminal associations, population density and powerful groups in society. Table 2.1 on page 73 indicates specifically which

of the theories incorporates each of the mentioned factors. Mathematically the function describing the net earnings from illegitimate activities can be extended as follows:

$$w_i = b - dc - m \quad \text{where} \quad m = m(a, g, i, fi, sub, ca, pd, pg) \quad (2.5)$$

where

- w_i is net earnings from illegitimate activities
- b is the benefit from illegitimate activities
- dc is the direct cost of illegitimate activities
- m is the moral cost of illegitimate activities
- a is age
- g is gender
- i is industrialisation
- fi is family instability
- sub is deviant subcultures
- ca is criminal associations
- pd is population density
- pg is powerful groups

Criminal associations, population density and powerful groups are factors which have additional effects on crime, over and above their effect on the moral cost of crime, and therefore must be considered separately. Opp (1989:410) believes that familiarity with criminals lowers the cost of committing crime to the individual for the following reasons: the internal cost of committing crime is lowered, cooperation results in improved organisation, more information is acquired concerning the expected punishment cost of committing crime and concerning crimes that are not punished. That is, ultimately the returns from criminal activities are raised owing to the lower moral cost of crime, the lower direct cost of crime and the more accurate calculation of the expected punishment cost of crime, respectively. Collectively these effects of criminal association are reinforcing and increase the crime rate.

Increased population density increases the number of strangers and social contact in the community. The increased number of strangers decreases the probability of punishment, as criminals are less likely to be identified, and decreases the moral cost of committing crime, as social control is weakened. The increased social contact, decreases the direct

cost of crime as it becomes easier for criminals to find potential victims. The net earnings from illegitimate activities are raised by the decreases in the direct and moral costs of committing crime. Finally, the return from criminal activity is also raised owing to the decrease in the probability of punishment. Collectively these effects are reinforcing and therefore increased population density is related to an increase in crime.

The powerful groups and individuals within a society have the authority to define legislation and apply it to others. Therefore the socially harmful activities of the powerful groups and individuals are ignored and their net benefit from such "criminal activities" is raised because the moral costs of committing "crime" and the expected punishment costs are nonexistent. Collectively these effects of power domination are reinforcing and increase the return from criminal activity and therefore crime.

The above discussion has focussed on the effect that the numerous economic and socio-economic variables, emphasized in the sociological structure and radical criminology theories, have on the rate of crime. The direction of change in these variables which causes crime to increase was stressed. Importantly, it was noted that changes in a particular variable may affect crime in opposite ways. Table 2.1 below summarises this discussion.

Table 2.1: Economic and Socio-Economic Variables and Non-Economic Theories of Crime

VARIABLE	RELATIONSHIP TO CRIME	MECHANISM BY WHICH CRIME IS INCREASED	ECOLOGICAL	ANOMIE		SUBCULTURE	OPPORTUNITY		RADICAL CRIMINOLOGY	
				DURKHEIM	MERTON		DIFFERENTIAL OPPORTUNITY	EMANCIPATION		FEMINIST
Median income	<u>negative</u>	<u>low w_1</u>	✓	✓	✓	✓	✓		✓	✓
	positive	high $b ::$ high w_1		✓					✓	
Unemployment rate	<u>positive</u>	<u>low w_1</u>	✓	✓	✓	✓	✓		✓	✓
	negative	high $b ::$ high w_1 (business related crime)						✓	✓	
Education	<u>negative</u>	<u>low w_1</u>	✓	✓	✓	✓	✓		✓	✓
	positive	high $b ::$ high w_1 (business related crime)						✓	✓	
Age	<u>negative</u>	<u>low w_1</u>	✓	✓	✓	✓	✓		✓	✓
	negative	low $m ::$ high w_1		✓		✓	✓			
Race	<u>minority</u>	<u>low w_1</u>	✓	✓	✓	✓	✓		✓	✓
Gender	male	low $m ::$ high w_1				✓	✓			
	female	emancipation :: high w_1						✓		
	<u>female</u>	<u>low w_1</u>	✓	✓	✓				✓	✓
	female	lenient CJS procedures :: low p and f								✓
Industrialization	<u>positive</u>	<u>low $m ::$ high w_1</u>	✓	✓					✓	
Family instability	<u>positive</u>	<u>low $m ::$ high w_1</u>	✓		✓					
Subcultures	<u>positive</u>	<u>low $m ::$ high w_1</u>				✓	✓			
Criminal associations	<u>positive</u>	<u>low dc, low $m ::$ high w_1, & accurate p and f</u>					✓			
Population density	<u>positive</u>	<u>low dc, low $m ::$ high w_1, & low p</u>		✓						
Powerful groups influencing law enforcement	<u>positive</u>	<u>zero $m ::$ high w_1, & zero p and f (often business related crime)</u>							✓	

* underlined variable relationships together constitute the economic variables traditionally ignored, indicators of "socio-economic status" or "access to conventional opportunities"

* italicized variable relationships together constitute the socio-economic variables excluded, causes of a lower moral cost of illegitimate activities

where
 w_1 is net earnings from legitimate activities
 b is the benefit from illegitimate activities
 w_2 is net earnings from illegitimate activities
 m is the moral cost of illegitimate activities
 CJS is the criminal justice system
 p is the probability of punishment
 f is cost of the median sentence
 dc is the direct cost of illegitimate activities

Using the economic model of the market for offences as the framework of analysis for incorporating the non-economic theories in an interdisciplinary theory of crime, ensures that the economic and socio-economic variables emphasized by these theories become an integral feature of the interdisciplinary analysis of crime causation, along with the variables conventionally considered by economists. It is obvious, but very important to emphasise, that the narrow focus on deterrence as a determinant of crime, which is the traditional economic approach, must necessarily be abandoned within an interdisciplinary analysis. The economic model of the market for offences must be considered in its broadest sense in order to realise its full potential in explaining crime causation. When incorporating the theories considered above in an interdisciplinary theory of crime causation, this specifically implies that the net earnings from legitimate and illegitimate activities gain prominence - where they were previously mostly ignored. As mentioned above economists had recognised these influences, although they had not systematically included them in developing the economic theory of crime and had largely ignored them in their empirical work. Howsen and Jarrel (1987) justifiably criticised economists for having considered most of the socio-economic factors as relating to criminal disposition or taste and therefore conventionally considering them as given in economic models.

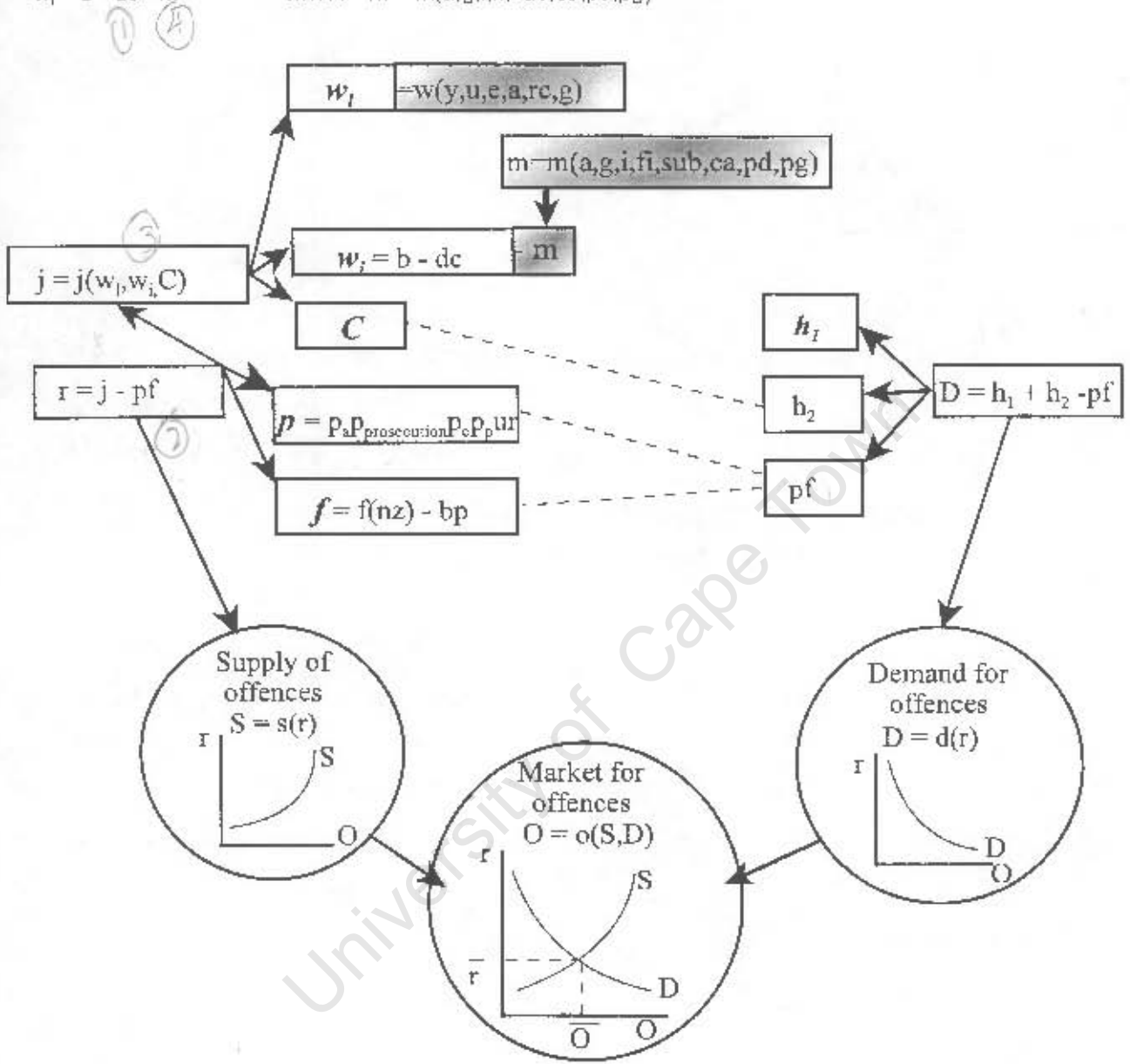
In order to consider the economic theory of crime in its broadest sense, the net earnings from legitimate and illegitimate activities must be formally included in the economic model of the market for offences in greater detail. In this study this is achieved by incorporating, respectively, equation 2.4 on page 69 and equation 2.5 on page 71 into equation 2.1 on page 59, which defines the supply of offences. The effect of income, the unemployment rate, educational achievement, age, race and gender on the net earnings from legitimate activities merits further attention within an interdisciplinary analysis. Regarding the net earnings from illegitimate activities, the effect of the moral cost of illegitimate activities is particularly important to consider. Ultimately the model of the market for offences is extended as illustrated in Figure 2.2.

Figure 2.2: Diagrammatic Representation of the Extended Neoclassical Model of Crime

$w_1 = w(y, u, e, a, rc, g)$

$w_2 = b - dc - m$

where $m = m(a, g, i, fi, sub, ca, pd, pg)$



- where
- w_1 is net earnings from legitimate activities
 - y is income
 - u is the unemployment rate
 - e is educational achievement
 - a is age
 - rc is race
 - g is gender
 - w_2 is net earnings from illegitimate activities
 - b is the benefit from illegitimate activities
 - dc is the direct cost of illegitimate activities
 - m is the moral cost of illegitimate activities
 - i is industrialisation
 - fi is family instability
 - sub is deviant subcultures
 - ca is criminal associations
 - pd is population density
 - pg is powerful groups

In terms of this interdisciplinary theory of crime causation, the influence of law enforcement, economic and socio-economic variables on crime are considered. As a result of this interdisciplinary approach, considerably more insight is gained regarding the variables which can be manipulated in order to raise the net earnings from legitimate activities and/or reduce the net earnings from illegitimate activities in order to prevent crime. The focus is no longer solely on raising the expected punishment cost of committing crime via criminal justice system activities in order to lower the crime rate. Not only is this the focus of the traditional economic theory of crime, but it is also to a great extent the current practice in crime prevention worldwide. In terms of the interdisciplinary theory of crime causation, it is possible to assess the merits of both traditional practices and theories as well as alternative proposals. Essentially in terms of an interdisciplinary theory of crime the activities of all government agencies, not only the criminal justice system, must be considered regarding their ability and effectiveness in crime prevention.

2.6 CONCLUSION

An important objective of this study is to investigate some of the possible causes of the high crime rate in South Africa. The conventional economic theory of crime was considered and it was determined that the main focus of economists has been on the influence of law enforcement variables on crime, although the economic model of the market for offences also suggests the importance of economic and socio-economic variables. In this study, however, the model of the market for offences was considered in its broadest sense as a paradigm for an interdisciplinary theory of crime.

An interdisciplinary approach to crime causation contributes substantially to the theory of crime. In terms of an interdisciplinary theory of crime, a framework for analysis is provided that identifies, orders and systematizes the various theories concerning crime causation. Within this framework it is easily recognised that the traditionally narrow focus of the economic theory of crime on law enforcement variables, inevitably lent itself to the exclusive use of the criminal justice system in crime prevention. Yet in South Africa and worldwide increased public expenditure on the criminal justice system is not reducing crime. An interdisciplinary theory of crime provides an integrated and consistent framework for a shift

in the debate on crime causation and the accompanying debate on appropriate crime prevention policy. In particular, in this study understanding is gained regarding the economic and socio-economic variables which could be manipulated in order to raise the potential criminal's net earnings from legitimate activities and/or reduce their net earnings from illegitimate activities. The interdisciplinary theory is a more refined and academically sound approach as it is scientifically based and yet allows for the assessment of the merits of competing theories in practical terms for the South African situation. Of particular interest, is the significance of law enforcement and other variables in South Africa. That is, whether the operations of the criminal justice system exclusively deter crime.

Unfortunately, as an interdisciplinary analysis of crime is based on the economic model of the market for offences in its broadest sense, the major causes of crime in South Africa are not easily recognised among all the possible causes presented when considering the interdisciplinary theory of crime. Yet, in South Africa and elsewhere, government funds are limited and it is therefore necessary to empirically estimate the model of the market for offences in order to identify the variables that are significant determinants of crime in order to be in a position to apply effective crime prevention policies. This empirical analysis will be undertaken in Chapters Three and Four. Little research of this nature has been conducted elsewhere in the world.

NOTES:

1. He, however, challenges the merits of using this paradigm for explaining crimes relating to immorality and the constitution of the political regime, such as victimless crimes or crimes of discrimination. In these cases society's preferences in terms of enforcement may not be compatible with the aims of the law.
2. Prior to this, the eighteenth century British economist Jeremy Bentham theorised about crime. Although he applied cost-benefit calculus to criminal behaviour, Becker's model is more sophisticated in many respects.
3. This assumption of rationality has been challenged by Sociologists. In many of their theories it is argued that criminal activity does not arise out of freedom of choice but that criminals pursue such activity as a result of a predisposition to crime beyond their control. Economists, however, argue that criminal activity which appears to be irrational in this sense can be explained by the fact that these criminals perceive the costs and benefits of criminal activity slightly differently from most people. However, these criminals are acting rationally. According to Reynolds (1980:34), 'I have found that even highly irascible people who, in a rage, seem to lose all control of their actions, still refrain from smashing really valuable objects, preferring cheaper crockery'.
4. For this to be the case, criminals must have a preference for crime. The moral preferences of individuals will be considered when the moral cost of committing crime is discussed on pages 69 to 71.
5. This discussion of the economic model used to describe the market for offences is based on the work of Ehrlich (1981), who elaborated on Becker's analysis of the supply of offences by considering, not only the behaviour of the offender and the criminal justice system, but also the behaviour of potential victims and the buyers of illegal goods and services.

6. As was mentioned above, the moral cost to individuals of committing crime is traditionally ignored by economists. If, however, it is considered, the assumption must be made that individuals are indifferent between legal and illegal activities or a continuous distribution of moral preferences must be assumed. If indifference is assumed, effectively the moral cost to individuals of committing crime is zero and the number of offences supplied will increase in proportion to increases in the return from criminal activity as defined in the text. When assuming a continuous distribution of preferences, higher and higher returns from criminal activity will attract more and more individuals as the returns exceed their "reservation wage".
7. Friedman (1986:459-463) deserves special mention for his analysis of the supply of offences, in which he showed how the shape of the supply curve changes when considering different combinations of marginal and talented criminals. His insights are, however, not central to the present discussion and will not be included.
8. Note that f must always exceed j because if this is not so then criminal activity will always be the optimal choice, even if $p=1$.
9. Clearly the modest focus of this study is on the factors determining the number of offences, as described by the model of the market for offences. Traditionally, economists have used this model to determine the optimal number of offences in order to minimize the cost of crime to society. The optimal number of offences is not zero and crimes should only be prevented when 'the costs of experiencing the avoidable crimes are greater than the costs of preventing those crimes' (Sedgwick 1984:47).
10. It should be noted that although the economic theory of crime is associated with the neoclassical school in economics, it is associated with the classical criminology paradigm.

11. It should be noted that many of these perspectives relate to the economic model of the individual's decision-making regarding participation in criminal activities as opposed to the model of the market for offences. In addition many attempt to explain delinquency as opposed to criminal activity. For the purposes of this study, the important aspects of these perspectives will be applied to explaining crime at an aggregate level.

12. Hughes (1993:57) stresses that as there is no common denominator by which to weigh moral positions in the same equation with the financial gains and losses of participating in criminal activity, the economic model is unable to predict participation schematically. He and other writers of the same school view this as a major problem because they believe that moral duty is, in fact, the most important determinant of crime. This criticism of the economic approach is, however, more relevant to individual level studies than to aggregate level studies, which are concerned with the influence of the socio-economic variables which affect moral positions on crime.

CHAPTER THREE

PRELIMINARY EMPIRICAL ANALYSIS

3.1 INTRODUCTION

In Chapter Two the economic theory of crime was considered in its broadest sense culminating in the development of an interdisciplinary theory of crime, which is able to accommodate the divergent foci in the debate concerning crime causation and prevention. The next step is to empirically assess the relative importance of the numerous variables which are believed to influence the crime rate in South Africa. 'Even if there is a joker in the human pack, in the shape of an element of free will, making the application of the scientific method less predictable in its effects, this is no reason for assuming that the behaviour of criminals cannot be influenced' (Bean & Whynes 1986:163).

'The causes of crime are not the same in all societies/countries. When the causes *are* the same, the degree of their influence varies in different societies. A better understanding of the causes and the degree of their influence on the societies make it possible to adopt policies that help develop the economy efficiently toward peace and prosperity' (Meera & Jayakumar 1995:456). The Nedcor report (1996:3) also states clearly that effective policy-making and implementation rely on statistical analysis. In this regard this study is unique, as it is the first attempt in South Africa to assess the relative importance of the various causes of crime in order to inform policy-making. A preliminary analysis is undertaken in this chapter, firstly the data used in the analysis is discussed and then the pairwise correlation results are presented and interpreted.

3.2 THE DATA AUDIT

As noted in Chapter Two on pages 57 and 58 the focus of this study is on the determinants of crime, and not criminality, and therefore an aggregate level study, as opposed to an individual level study, is undertaken. A cross-section of South African magisterial districts is used for this purpose. According to Cornwell and Trumbull (1994:360) most studies use aggregate data of a higher level of aggregation than magisterial districts. The study is based on the broadest interpretation of the economic model of the market for offences in terms of

important variables to consider. From the interdisciplinary theory of crime developed in the previous chapter the important crime causation variables were identified and for each, a range of appropriate proxies are considered. Other empirical studies on crime determination which were reviewed also provided information on proxy variables which can be incorporated.¹ In many instances the range of proxies include inequality measures as well as traditional measures of the level of a variable. The table below indicates the numerous proxy variables which are considered in this study as important determinants of the South African crime rate.

Allowing for the fact that a study of this nature has never been conducted in South Africa, collecting data for the study was a massive and time consuming undertaking. This task was, however, pursued with vigour in order to make the empirical analysis of the market for crime in South Africa possible.

Table 3.1: Important Determinants of the Crime Rate

Variable Name	Proxy
Probability of Punishment	Probability of Prosecution, given Crime Probability of Prison Sentence, given Crime
Cost of the Sentence	Average Length of Prison Sentence Expected Prison Sentence, given Crime
Income	Average Household Income Poverty-gap Index Poverty-gap Index (calculated using expenditure) Median Income Standard Deviation in Income Gini Coefficient
Unemployment	Unemployment Rate (expanded definition) Unemployment Rate (narrow definition) Male Unemployment Rate (expanded definition) Male Unemployment Rate (narrow definition)
Education	Average Number of Years of Education Median Number of Years of Education Proportion of Population with Primary Education Proportion of Population with Secondary Education Proportion of Population with Tertiary Education Standard Deviation in Education Years
Age	Average Age Median Age Proportion of Population Younger than 15 Years Proportion of Population Younger than 18 Years Proportion of Population Younger than 25 Years Proportion of Population between 16 and 25 Years Proportion of Population between 16 and 25 Years
Race	Non-White/White Race Ratio Black/Others Race Ratio Black and Coloured/Others Race Ratio Black/Others Ratio of Average Income Black/Others Ratio of Median Income Black/Others Ratio of Average Education Years Black/Others Ratio of Median Education Years Black/Others Ratio of Proportion with Primary Education Black/Others Ratio of Proportion with Secondary Education Black/Others Ratio of Proportion with Tertiary Education Black/Others Ratio of Unemployment Rate (expanded definition) Black/Others Ratio of Unemployment Rate (narrow definition)

Variable Name	Proxy
Race	Black and Coloured/Others Ratio of Average Income Black and Coloured/Others Ratio of Median Income Black and Coloured/Others Ratio of Average Education Years Black and Coloured/Others Ratio of Median Education Years Black and Coloured/Others Ratio of Proportion with Primary Education Black and Coloured/Others Ratio of Proportion with Secondary Education Black and Coloured/Others Ratio of Proportion with Tertiary Education Black and Coloured/Others Ratio of Unemployment (expanded definition) Black and Coloured/Others Ratio of Unemployment (narrow definition)
Gender	Female/Male Gender Ratio Female/Male Ratio of Average Income Female/Male Ratio of Median Income Female Average Income Female Median Income Female/Male Ratio of Average Education Years Female/Male Ratio of Median Education Years Female Average Education Years Female Median Education Years Female/Male Ratio of Proportion with Primary Education Female/Male Ratio of Proportion with Secondary Education Female/Male Ratio of Proportion with Tertiary Education Female Proportion with Primary Education Female Proportion with Secondary Education Female Proportion with Tertiary Education Female/Male Ratio of Unemployment Rate (expanded definition) Female/Male Ratio of Unemployment Rate (narrow definition) Female Unemployment Rate (expanded definition) Female Unemployment Rate (narrow definition)
Working Mothers	Proportion of Mothers that Work
Economic Development	Workers in Manufacturing as Proportion of the Economically Active Workers in Service Industry as Proportion of the Economically Active Ratio of Agricultural Workers to Workers in Manufacturing Ratio of Workers in Manufacturing to Service Industry Workers
Family Instability	Proportion of Households in which there is Divorce Proportion of Female Headed Households Proportion of Households in which there is Marriage
Subcultures	Presence of Gang Activity
Population Density	Population Per Square Kilometer Proportion of Population that Resides in Urban Area

Unfortunately the empirical analysis was limited in numerous ways. Primarily, it was limited in terms of the time period and geographical areas that could be considered. The biggest time constraint on data availability emanates from the inadequacy of Department of Justice statistics. The last available statistics are for the year of 1994/1995 and no more data will be made available publicly until a new information technology system has been installed. Given this constraint, a cross-sectional analysis could only be undertaken relating to crime committed in 1994. South African crime statistics prior to 1994 are generally considered to be unreliable because homeland police forces operated independently until the demise of the apartheid system and therefore aggregated data is not strictly compatible. Bearing in mind that there is a time delay between the period in which crime is committed and the criminal justice system processing thereof, the crime statistics for 1994 were considered along with the 1994/1995 Justice Department statistics and the 1995 Department of Correctional Services statistics. Effectively it is assumed that there is approximately a six month delay before the processing of a crime case is completed in both the departments of Safety and Security and Justice. It should be noted that Cornwell and Trumbull (1994) caution against the use of cross-section data which tends to overstate the deterrent effects of the criminal justice system, while understating the ability of economic and socio-economic variables to reduce crime.²

Owing to the unavailability of data, certain magisterial districts had to be excluded. In this regard the information provided by the Department of Correctional Services is the most limiting. Ultimately only ninety of the three hundred and seventy five magisterial districts could be included in the analysis. There is no statistical justification for the choice of the ninety districts which were considered as they were not randomly selected, therefore potential biases in the data cannot be ruled out. The magisterial districts included are those in which there are prisons and therefore non-urban areas are under represented. Besides the general criticisms concerning the use of predominantly urban data, it must also be noted that it is possible that the quality of crime data in these areas may differ from that nationally, as the extent of under reporting and recording of crimes may be lower.

These time and geographical constraints pose a severe limitation on South African studies concerning crime and it is important to note that statistics collected throughout the entire criminal justice system need to be revised in terms of their ability to provide relevant information for crime prevention. To this end in 1997 the Minister of Safety and Security appointed a Committee of Inquiry into the collection, processing and publication of crime statistics. 'The Committee found that the lack of public awareness and confusion about where and when crime statistics can be accessed from the police, and which police officials are authorised to release data, requires the urgent clarification of the Ministry of Safety and Security's policy on dissemination' (Department of Safety and Security 1998:52). These problems have still not been resolved. In conducting this study the author was faced with many obstacles in terms of data collection and, despite persistent attempts, no magisterial district level data was obtained from the South African Police Service. Under-staffing in the Crime Information Management Centre is the main obstacle to building an information-culture within the police (Department of Safety and Security 1998:51). This problem is compounded because police also disseminate court related information. '[T]he police should not be responsible (as is currently the case) for collecting court related statistics since this is not their operational area of jurisdiction, and as a consequence, the reliability of court statistics is likely to be questionable' (Department of Safety and Security 1998:47).

This empirical analysis was also limited in terms of the other categories of information collected in South Africa. Information relating to the following is either not available at all, or not available in a compatible format: the expected punishment of female offenders vis-a-vis male offenders, the number of known criminals in the area, the presence of powerful groups in the area and police presence in the area. This limits the ability to test the interdisciplinary theory of crime causation in South Africa as certain aspects of the Neoclassical Economic, Differential Opportunity and Radical Criminology theories cannot be tested.

The most appropriate source of data for this study is the Human Science Research Council's Geographic Information System because it is the only data base that has crime, economic and socio-economic information relating to 1994 that is compatible as it relates

to uniformly defined magisterial districts. The two specific data bases that contain most of the required information are the crime data base and the October Household Survey data base.

The crime data base is based on information supplied by the South African Police Service concerning recorded crimes. Although reporting formats and data classification and collection are consistent throughout South Africa, it is important to bear in mind that the number of recorded crimes is influenced by the extent of under reporting and police recording. Information on the total crime rate per 100 000 people in each magisterial district for the year of 1994 was obtained from the crime data base. It was derived by summing the incidence of all crimes³, excluding the minor offences illegal strikes, *crimen injuria* and driving under the influence of substances, and then dividing by the number of people (100 000) in the district.

Police recording of reported crimes may differ between areas, also between urban areas, if this is the case it will bias the empirical conclusions drawn when analyzing the data. Police officers may have an incentive to manipulate official data purposefully, for example the crime rate may be lowered in a particular area to encourage tourism or raised as a rent-seeking ploy for bigger budgets. According to the National Crime Investigation Service of the South African Police Service this does not have a significant impact on statistics because even though '[t]he use of discretion by police officers in the SAPS [South African Police Service] is widely acknowledged. There are, however, certain guidelines such as Laws, Statutes and Regulations to which a police officer is bound' (Senior Superintendent W.J. Schoeman, pers. comm. 31 January 1996). According to the South Africa Foundation (1996:30), under reporting of crime in black communities during the apartheid era was as a result of the mistrust of the police, owing to their illegitimacy as a law enforcement agency, and ineffectual policing, caused by the misallocation of police resources. 'The extent of the shortfall is not known, or how it has changed over time' (South Africa Foundation 1996:30). Also, it is common knowledge that different crimes have different reporting patterns, with property crime likely to have higher reporting rates than commercial crime and crimes like blackmail and rape.⁴ Nonetheless most of the individual level

victimization studies that were conducted in South Africa are limited in their scope and only one national victimization study was conducted, in 1997. Ultimately there is no other source of crime information that is comprehensive enough for the purposes of this study than the South African Police Service statistics. Under reporting remains but given that the focus in this study is on the relative incidence of crime amongst different regions and time periods as opposed to the level of crime incidence, this is not problematic unless the pattern of under reporting differs substantially.

The October Household Survey is based on research undertaken by the Central Statistical Service (now Statistics South Africa). It must be noted at the outset that the sample data is not fully representative of the magisterial district population. The October Household Survey is representative of the population only at provincial and higher levels of aggregation. Although weights are provided with the data base, as they only ensure appropriate adjustments at higher levels of aggregation than magisterial districts, they were not applied because they have the potential to exacerbate or introduced biases. The fact that the data is not fully representative of the population is acknowledged, however, it was used as there is no other better source of information available.

The October Household Survey provides the 1994 information per magisterial district concerning income earned, the unemployment rate, educational attainment, age, race, gender, mothers, the degree of economic development⁵, the extent of family instability and population density. In order to conduct the empirical analysis, measures for each of these variables were derived. These are indicated as proxies in Table 3.1 on page 83.

Generally the proxy names in Table 3.1 provide a clear indication of how the proxies are formulated. However, the following needs to be noted. Initially the education attainment variable was coded in terms of educational categories. For the purposes of this study the variable was recoded in terms of number of years of education attained but two categories were excluded, other and unspecified. Hence all the education related variables do not include the entire sample population. Regarding the age related variables, it was necessary to consider the proportion of the population that were juveniles. Table 3.1 can be consulted

for the age groupings considered. Those younger than fifteen are believed to be an important group in South Africa because their criminal intent is considered questionable and those younger than eighteen because they are legally defined as juveniles. Those younger than twenty five were also considered in order to conform to many international studies. In order to calculate the proportion of households in which there is marriage, those in which an individual indicated spouse as their relationship to the (acting) head of household were considered. This was done in order to avoid possible errors which may have occurred if respondents understood married, as a marital status option, to mean a marriage in terms of civil law.

The 1995 Income and Expenditure Survey conducted by the then Central Statistical Service was also used to provide more reliable income information at magisterial district level, specifically in order to calculate the gini coefficient and poverty-gap index, albeit for 1995. The poverty-gap index was also calculated using expenditure data. The poverty line used to determine the poverty-gap indices was R180,60. The September 1995 Household Subsistence Level, calculated by the University of Port Elizabeth's Institute for Planning Research, of R903,00 for a five member household was divided by five to arrive at this per capita poverty line. The Household Subsistence Level is a consumption based poverty line.

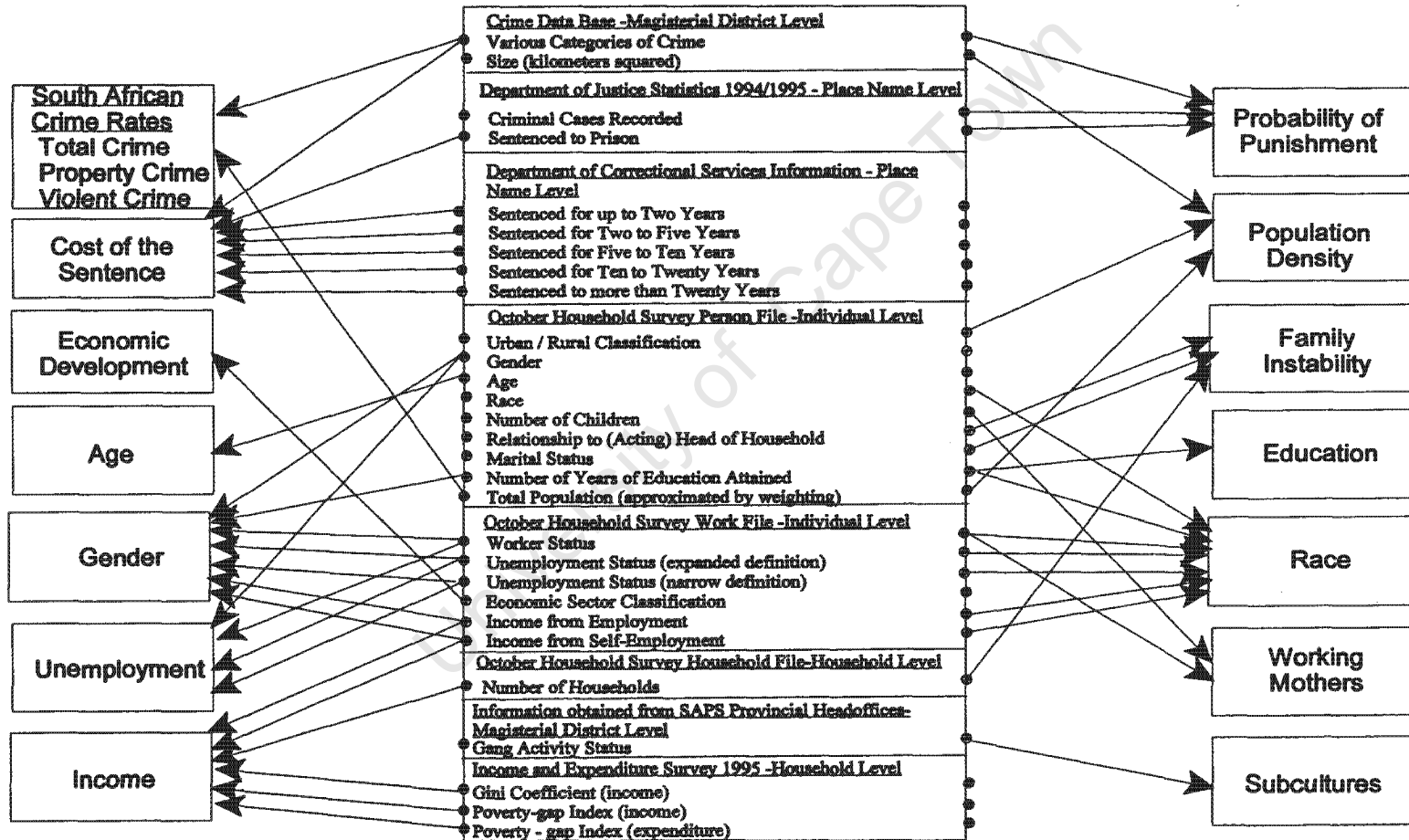
The information required to calculate the prosecution and punishment rates and the average and expected punishment is not available in the Geographic Information System format. This information had to be directly obtained from the Department of Correctional Services and from the publications of the Department of Justice. The information had to be adjusted in order to ensure its compatibility with the magisterial districts defined in the Geographic Information System. In order to calculate the prosecution rate, the number of cases that were recorded by the Justice Department for the year of 1994/1995 were taken as a proportion of the number of serious crimes in 1994. The imprisonment rate was similarly calculated using Justice Department data concerning the number sentenced to prison. The average prison sentence was calculated using Correctional Services data for 1995 prison sentences. For this purpose an index was constructed so that the average sentence is the sum of: one times the number sentenced for up to two years, three and a

half times two to five year sentences, seven and a half times five to ten year sentences, fifteen times ten to twenty year sentences and twenty five times sentences in excess of twenty years divided by the total number of sentenced prisoners. In order to derive the expected prison sentence, it was multiplied by the probability of receiving a prison sentence.

Data regarding gang activities within magisterial districts in 1994 is not readily available from the national office of the South African Police Service. Each of the nine provincial offices had to be approached individually in order to establish in which areas gang activity occurred. Gang activity status is a dummy variable containing this information.

Figure 3.1 below is a schematic representation indicating which information from the different sources was applied to formulate the various proxies for the variables which potentially influence crime, and the crime rate. Table 3.1 on page 83 lists the proxies for each explanatory variable that were considered in this study.

Figure 3.1 Data Base and Other Information used to Create Magisterial District Level Variables Considered to be Important Determinants of the Crime Rate



3.3 THE PAIRWISE CORRELATION RESULTS

Having assembled all the necessary data, it was possible to proceed with the empirical analysis. In this preliminary investigation the correlation between various law enforcement, economic and socio-economic variables and the total crime rate was considered. All the proxies in Table 3.1 on page 83 were analyzed, however, for the purposes of this research it was decided only to include the variable in each category which had the highest level of significance attached to the correlation coefficient.⁶ In the table below the Pearson pairwise correlation results are given. Groups of variables which are expected to have the same sign(s) on their correlation coefficients are grouped together but each is separated by a forward slash.

In order to meaningfully interpret these results, it is important to refer back to the previous chapter in which an interdisciplinary theory of crime causation was developed. Table 2.1 on page 73 is particularly useful as it clearly indicates the hypothesised relationships between the economic and socio-economic variables and the crime rate and the reasons for this. Figure 2.2 on page 75 represents the entire model of the market for crime, including the law enforcement variables that have traditionally been the focus of economic crime theories. The law enforcement variables, the probability of punishment and the cost of the sentence, affect both the supply and demand for offences. The effects are, however, not contradictory as in both cases greater deterrence shifts the curve leftward and therefore results in a reduction in the number of offences. Except for population density which also influences the probability of punishment, the other economic and socio-economic variables all influence only the supply of offences, via their effects on the net earnings from legitimate activities and on the net earnings from illegitimate activities. These effects are more often than not contradictory and therefore care must be taken in interpreting empirical results.

Table 3.2: The Pearson Pairwise Correlation between the Total Crime Rate and Important Variables

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
Law Enforcement	Probability of Prosecution, given Crime	negative	-0.2599	0.0134**
	Average Length of Prison Sentence	negative	-0.043	0.6871
Economic	Poverty-gap Index	negative	-0.1091	0.3059
	Median Income / Gini Coefficient	positive	0.1117 -0.0551	0.2947 0.6059
	Unemployment Rate (expanded definition)	positive	-0.0791	0.4585
		negative (business related)		
	Average Number of Years of Education	negative	-0.2402	0.0226**
		positive (business related)		
	Standard Deviation in Education Years	positive	-0.2808	0.0074***
	Average Age	negative	-0.2101	0.0468**
	Proportion of Population Younger than 15 Years	positive	0.1866	0.0782*
	Black and Coloured/Others Race Ratio	positive	0.0535	0.6353
	Black and Coloured/Others Ratio of Median Income	positive	0.3037	0.0425**
	Black and Coloured/Others Ratio of Average income /	negative	-0.0139	0.9058
	Black and Coloured/Others Ratio of Proportion with Primary Education	positive (business related)	-0.1437	0.2125
	Black and Coloured/Others Ratio of Unemployment Rate (narrow definition)	positive	-0.0856	0.5501
		negative (business related)		
	Female/Male Gender Ratio	negative	-0.1151	0.28
	Female Median Income	positive	0.0508	0.6343
	Female Average Income / Female Average Education Years	negative	-0.2370	0.7002 0.0245**
		positive (business related)		
	Female/Male Ratio of Unemployment Rate (narrow definition)	positive	-0.1787	0.1359
negative (business related)				
Socio - Economic	Proportion of Mothers that Work	positive	-0.0648	0.5441
	Ratio of Workers in Manufacturing to Service Industry Workers	negative	-0.2062	0.0801*
	Proportion of Female Headed Households	positive	-0.15	0.1582
	Presence of Gang Activity	positive	-0.0935	0.3809
	Proportion of Population that Resides in Urban Area	positive	-0.2163	0.0406**

* 90 percent level of confidence

** 95 percent level of confidence

*** 99 percent level of confidence

The law enforcement variables, probability of prosecution given crime and average length of prison sentence, are indeed negatively related to the overall crime rate in South Africa as predicted in the theory of crime.⁷ The other variables that display negative signs on the correlation coefficients which are explicable in terms of an interdisciplinary theory of crime are all the unemployment rate measures, average age and the ratio of workers in manufacturing to service industry workers. The ratio of workers in manufacturing to service industry workers decreases as economic development occurs and the crime rate increases. All the unemployment rate variables⁸, including the race and gender measures, are negatively related to crime. In terms of an interdisciplinary crime theory this appears to indicate that unemployment is important in determining business related crimes specifically.

The following variables display signs on the correlation coefficients which are puzzling in terms of an interdisciplinary theory of crime. The income Gini coefficient⁹ is most often thought to be positively related to the crime rate. This is also thought to be the case for standard deviation in education years. Yet it appears that the greater the inequality in income and educational attainment in an area, the lower the crime rate. This relates to the homogeneity within societies referred to in many of the sociological theories of crime, especially the subculture theories. These theories generally imply that a common income and educational experience facilitates crime. Therefore, in terms of the interdisciplinary approach it must be acknowledged that inequality variables could be negatively related to crime. That is, the greater the inequality in society, the lower the net earnings from illegitimate activities as potential criminals do not have the same life experience and therefore the lower the crime rate.

The proportion of mothers that work should have a positive sign according to Hagen's theory. This is not the case in South Africa and it is evident that the financial contributions of working women discourage crime, probably owing to the fact that average household income is raised. The possibility of this relationship should also be recognised in terms of an interdisciplinary framework.

Contrary to theoretical expectations, the proportion of female headed households is negatively related to crime in South Africa. LaFree et al. (1992) also found this negative relationship in their study. However, in this study all the measures of family instability considered seem to indicate that non-conventional family structures lower crime. Obviously it must be conceded that traditional families based on marriage may be criminogenic, when there is friction and the structure remains despite harmful interpersonal relations. An interdisciplinary theory must acknowledge that non-conventional family structures may raise morals, probably owing to greater honesty and maturity in dealing with situations, thereby lowering the net earnings from illegitimate activities and therefore crime.

The proportion of the population residing in an urban area is negatively correlated with the crime rate. In their research Howsen and Jarrel (1987) use a measure of urbanisation that is squared. This is necessary as they believe that the relationship between population density and the crime rate is not linear, it is negative at first and then positive. When adopting an interdisciplinary perspective this hypothesised relationship should be considered. That is, initially the increased population density accompanying urbanisation results in increased official law enforcement capacity and familiarity among people, this increases the direct and moral costs of pursuing crime and also raises the probability of punishment and therefore lowers the crime rate.

According to the subculture theories the presence of gang activities should foster crime. Yet the intercept dummy variable (Hamilton 1998:149) for the presence of gang activities is negatively related to the crime rate. In order to obtain the information regarding gang activities, the nine provincial head offices of the South African Police Service had to be approached individually as there is no national gang crime prevention unit. From the information received it appears that, either the definition of gangs was not clearly understood, or the person tasked with providing the information did not have the correct information. Nonetheless, this data is not reliable enough and will not be considered in this study.

It is interesting to note that while median income is positively related to the crime rate, the income poverty-gap index is negatively related to crime. Wong (1995:237) emphasises the importance of distinguishing income related variables which influence the returns from illegitimate activities from those that influence the returns from legitimate activities. Median income is related to the income earning population and therefore to the potential earnings from undertaking criminal activities which victimize this population, while the poverty-gap is related to the proportion of the population that is largely marginalised in terms of earnings from legitimate employment. This relationship between income variables and the crime rate remains evident when considering the gender and race variables median and average income. Where average income is an indicator of potential earnings from legitimate employment.

It should also be noted that the average number of years of education is a significant determinant of the crime rate. Education is a deterrent to crime but the level of education attained is important. In terms of the general education measures it is evident that education is only a crime deterrent above the primary education level. In fact, the proportion of the population with primary education is positively related to the crime rate, this seems to indicate that basic education is not sufficient to deter crime and may actually encourage it. All the education measures which involve race or gender comparisons are less significant but they show education as a deterrent at the lower levels. However, the comparative proportion of the population with tertiary education is positively related to the crime rate, which indicates business-related crime.

When considering the age variables measuring the proportion of youth in the population, it is interesting to note that the variables which exclude the one to sixteen year-olds display the incorrect signs on the correlation coefficients. This appears to imply that in South African terms, youths involved in crime are indeed very young.

In terms of the race measures considered the Black and Coloured to others race ratio was the most significant, significance decreased as less marginalised groupings were included in the measure. Unfortunately all the race measures comparing the Black population to others had to be disregarded, as closer inspection of the data indicated

that in many magisterial districts no Black people had been included in sample and that generally Black people were under represented in the 1994 October Household Survey.

The female to male gender ratio is negatively related to crime, confirming the general belief that most crime is committed by men. However, when considering all the gender measures relating to economic variables, except for the unemployment rate, they appear to indicate that female marginalisation is relevant to the South African situation as an explanation of crime causation, more so than female emancipation. As the measures considered were the female level of income and education, which are in fact female emancipation indicators, this lack of emancipation as a cause of crime is clearly evident. The marginalisation hypothesis is also predominant when all the race measures are considered, once again except in the case of the unemployment rate.

The various law enforcement, economic and socio-economic variables can be ordered in terms of their relative importance as determinants of the crime rate by considering the level of significance in Table 3.2 on page 93. It should be noted that the most important determinants of crime in South Africa appear to be the economic variables, the education variables are the most significant of these. Three of the nine variables that are significant in determining South African crime rates are education variables. The age variables are also extremely significant crime determinants. Variables relating to race and gender were considered and thus attention was given to the extent of inequality displayed by the economic variables, as opposed to the level of the variables alone, when regarding their relevance in explaining crime. This was insightful as one of the significant variables is a race variable and another a gender variable, Black and Coloured/others ratio of median income and female average education years respectively. Law enforcement variables are also significant determinants of crime. The probability of prosecution is significant in determining crime. As predicted in neoclassical economic theory, the probability of prosecution is far more significant as a deterrent than the probability of a prison sentence, which is more deterring than the magnitude of punishment. The socio-economic variables, however, also appear to be more important determinants of crime than the law enforcement variables and need to be included when the model of the market for offences in South Africa is estimated. The ratio of workers

in manufacturing to service industry workers and the proportion of the population residing in an urban area are significant crime determinants. Given this outcome, it is clear that an interdisciplinary approach to crime causation is superior to a narrow approach based on any specific theory.

According to the Nedcor report (1996:20-21), specific crime prevention strategies are needed for each type of crime if preventative policy is to be most effective. To this end information on the property crime and violent crime rates per 100 000 people in each magisterial district for 1994 was also obtained from the crime data base. It was derived by summing the incidence of all crimes within the particular class¹⁰ and then dividing by the number of people (100 000) in the district. Unfortunately for 1994 no information is available regarding the probability of punishment and the cost of the sentence relating specifically to property crimes and to violent crimes. Hence the property crime rate is correlated with the same variables that were considered when this was done for the total crime rate. The violent crime rate is also correlated with these variables.

The information regarding the pairwise correlations can be found in Tables C.1 and C.2 in Appendix C on page 258. The most significant variables in each category have been highlighted. The results are, however, not very different from those obtained when the total crime rate was studied. Mention will only be made of the exceptional results. In both cases when considering the racial composition of areas, the Non-White to White race ratio is a more significant crime determinant than the Black and Coloured to others race ratio. In both cases, the female to male ratio of median income is more significant than female median income and the sign on the correlation coefficient is negative as opposed to positive. This is probably an indication that male median income is a more significant determinant of the potential earnings from undertaking criminal activity than female median income. Also in both cases, the proportion of the population between the ages of sixteen and twenty five is a more significant determinant than the proportion younger than fifteen years and the sign on the correlation coefficient becomes negative. Although this variable has the wrong sign, it will be used in the analysis as it is a standard measure of the proportion of youth in the population which has been used in many international studies.¹¹ In the case of property crime, the expanded definition of

unemployment is more significant when considering the Black and Coloured to others unemployment rate ratio than the narrow definition.

In a few other instances the signs on the correlation coefficients change but this is not decisive as none of these variables are the most significant in the given category. Also in some instances variables that were significant in terms of a 90, 95 or 99 percent level of confidence when the total crime rate was considered, are no longer significant or are less significant. Only one variable that had not previously been significant now becomes significant, the variable Black and Coloured to others ratio of proportion with primary education in the case of violent crime. In all instances more differences are noted with respect to the results of the violent crime rate analysis.

3.4 CONCLUSION

Within the context of an interdisciplinary theory of crime, several variables which could possibly be important crime determinants in South Africa were identified. However given the complete absence of some information and the time and geographical limitations of other information, not all the identified variables could be considered empirically over the desired time periods and regions. Nonetheless, seventy eight variables were considered which relate to crime that occurred in ninety magisterial districts in 1994. The data audit provides the necessary information regarding the original sources of all data used as well an explanation of the variables derived from this for the purposes of this research.

These variables were analyzed in order to assess the relative importance of the various law enforcement, socio-economic and economic variables in determining the South African crime rate. From the results it is clear that no one category of variables predominantly explains crime in South Africa. The interdisciplinary approach to crime causation adopted in this study is therefore appropriate as all the theories concerning crime causation, both the economic and non-economic, add important insights into the crime problem. In terms of crime prevention policy, the current narrow focus on criminal justice system reform seems inappropriate in South Africa. Especially given that education variables, particularly, are such significant determinants of crime, irrespective of whether the total crime, property crime or violent crime rate is considered. Alternative

*20 years down in the field
criminal justice*

methods of crime prevention that relate to the direct causes of crime must be considered.

Essentially the activities of various government agencies, not only the criminal justice system, must be considered regarding their ability and effectiveness in crime prevention if the government is to address the crime problem appropriately. However until the South African market for offences is formally modelled the major causes of crime are not easily recognised among all the possible causes, as the introductory empirical analyses yielded many results which appear to be ambiguous. In Chapter Four the market for crime in South Africa will be modelled in order to get a clearer indication of the fundamental causes of crime.

NOTES:

1. More information about the explanatory variables that were used in these studies is provided in Table 4.5 on page 129, Table 4.6 on page 141 and Table 4.7 on page 150 in Chapter Four.
2. See pages 105 and 106 in Chapter Four for a more detailed explanation of this bias.
3. The categories of crime included in the South African Police Service's data base were listed in the first note to Chapter One on page 47. It was noted that in 1994 no information was collected for the last four categories listed. In Chapters Three and Four of this thesis magisterial district level data is analyzed, it was not obtained directly from the South African Police Service but from the Human Science Research Council's crime data base. Unfortunately this crime data base did not provide information on the following crimes: murder, illegal possession of firearms and illegal possession/use of explosives and they therefore are necessarily excluded in the total crime analyses.
4. Fear of embarrassment, retaliation or victimization causes victims to be reluctant to make such crimes public.
5. The degree of economic development is considered as opposed to the degree of industrialisation. Although the Marxist, Ecological and Anomie theorists considered industrialisation specifically, in a modern day context this dated indicator of economic development must still be considered but within a broader context.
6. The initial correlation results are shown in Table B.1 in Appendix B on page 255. The entire data set of the variables can be obtained from the author at the e-mail address: ecakvb@upe.ac.za.

7. It should be noted that in terms of economic theory the probability of prison sentence given crime should be used when the market for crime is formally modelled. However as the probability of prosecution given crime is far more significant and because this data is far more reliable, it was decided to include this variable in further empirical analyses. Also in terms of economic theory it was necessary to use the average length of prison sentence, and not expected prison sentence given crime, in further empirical analyses. Expected prison sentence is an important concept in the economic theory of crime but it is, in fact, an interaction variable which was calculated as the probability of prison sentence multiplied by the average length of sentence.
8. LaFree et al. (1992:166) point out that the male unemployment rate should also be considered as a general unemployment rate measure if most crime is perpetrated by males.
9. The Gini coefficient relating to income was selected as the income inequality variable to consider, although the standard deviation in income was more significant. As none of the variables was highly significant, it was decided to include the Gini coefficient as it is a more standardized economic measure of inequality.
10. The specific crimes included in the property and violent crime categories were listed in Section 1.7 on pages 42 and 43. It must, however, be noted that information regarding the number of murders in 1994 was not provided in the crime data base used and it could not be included in the violent crime analyses in Chapters Three and Four.
11. Table 4.5 on page 129, Table 4.6 on page 141 and Table 4.7 on page 150 in Chapter Four can be consulted for further details regarding the particular studies in which this variable was used.

CHAPTER FOUR

MODELLING CRIME CAUSATION IN SOUTH AFRICA

4.1 INTRODUCTION

In Chapter Three a preliminary analysis of South African data was undertaken which was aimed at uncovering possible explanations for the high crime rate. Importantly it was found that significant crime determinants include, not only law enforcement variables, but also socio-economic and economic variables. Thus it appears that alternative methods of crime prevention which relate to the direct causes of crime should be considered. However before any policy recommendations can be made with confidence, the South African market for offences must be modelled formally as the correlation results provided in Chapter Three on page 93 only consider the relationship between the crime rate and each explanatory variable in isolation.

At the beginning of this chapter existing international empirical research is reviewed in order to provide information concerning the appropriate model specification. The models for total crime, property crime and violent crime are then estimated. In the next section these results are compared to those of similar international studies and interpreted. Finally the policy implications for effective prevention of each category of crime are discussed.

4.2 REVIEW OF EXISTING RESEARCH

'Economists address the issue of deterrence since the orthodox economic model itself is a model of deterrence' (Wynarczyk 1999:46). As explained in Chapter Two on page 57, there was general consensus among economists that the expected punishment criminals faced should be manipulated to affect the crime rate. Primarily because changes in the criminal justice system were believed to impact entirely on the crime rate, whereas other changes in public policy were believed to impact on crime only indirectly and on other social issues. Many of the earlier econometric studies undertaken by economists focussed, not only on estimating the deterrent effects of the probability and severity of punishment, but specifically on the deterrent effect of capital punishment.

Principally the aim of such studies was to challenge the abolitionist views that are well entrenched in sociology and criminology. Owing to the work of economist Isaac Ehrlich capital punishment was restored in the United States of America in 1976, largely because it was empirically ascertained that it had been a significant deterrent to murder (Cornwell & Trumbull 1994:360, Wynarczyk 1999:44).

Although an international literature survey of empirical studies was conducted for the purposes of this research, it seems appropriate to confine the discussion to the deterrence literature at the outset. Many of the important empirical modelling issues are, in fact, raised within this literature. Cornwell and Trumbull (1994) provide a review of the more important empirical analyses which comprise the deterrence literature. In all of the reviewed articles a cross-sectional research design was used. In most cases aggregate level data was considered, usually at the state or national level. Approximately half of the reported regressions were estimated by the ordinary least squares procedure. The remainder were estimated, either by two, or three stage least squares estimation procedures. 'In these studies, researchers were focused [sic] on conventional sources of endogeneity (simultaneity), such as those arising from the dependency of the probability of arrest or the size of the police force on the crime rate' (Cornwell & Trumbull 1994:361).

Cornwell and Trumbull (1994:360) reach the same conclusion as Wynarczyk (1999:43-44) that '[t]he econometric evidence consistently supports theoretical predictions of deterrent effects associated with both the certainty and severity of punishment'. Cornwell and Trumbull (1994:360-361) quote Hirsch 'it appears that an increase in law enforcement activity that increases either the probability of punishment or the severity of punishment by 1 percent is on the average associated with a reduction in the number of offenses [of] somewhere between 0.3 and 1.1 percent. ... *though the true value of the coefficient is probably closer to 1 than to 0.3*'. According to their research review 'the estimated arrest elasticities tend to confirm Hirsch's assertion' (Cornwell & Trumbull 1994:361). They also found that the greatest deterrent effect on crime results from the probability of arrest, followed by the probability of conviction, given arrest and then the

probability of imprisonment, given conviction (Cornwell & Trumbull 1994:361). This verifies the theoretical prediction of the economic model of the market for offences.

Cornwell and Trumbull undertook their own research which also focussed on the deterrent effects of the probability and severity of punishment but their aim was to determine the statistical importance of controlling for unobserved heterogeneity. Cross-section econometric techniques are not able to 'capture jurisdictional differences in crime reporting [and other criminal justice system procedures] without data on *actual crimes*' [my italic] (Cornwell & Trumbull 1994:362). 'This is even true of studies which estimated simultaneous equation models' (Cornwell & Trumbull 1994:361). They emphasise that as a result of neglecting to account for this form of endogeneity, the estimated deterrent effects of raising the probability of and severity of punishment are overstated. For the purpose of this research it is also important to note that, according to their empirical results (Cornwell & Trumbull 1994:365), the significance of economic and socio-economic variables is understated when heterogeneity is not accounted for.

Using panel data on reported crimes, Cornwell and Trumbull are able to condition on county effects in estimation. In this study the units of observation are the counties in North Carolina. Compared to other studies this is a relatively low level of aggregation. The independent variables considered were: the probabilities of arrest, conviction and imprisonment, the average prison sentence length, the average weekly wage in various industries, a dummy variable indicating urban status, population density, dummy variables for western and central counties, the male population between the ages of 15 and 24, the non-white population and the number of police per capita. In order to compare cross-section and panel data estimates, the model equation was transformed in two ways. In the first, data was expressed as county means and in the second as deviations from county means. In both cases the ordinary least squares procedure can be used and if conventional simultaneity occurs, the two stage least squares procedure is appropriate. Cornwell and Trumbull considered both sets of data using both estimation procedures, adopting a log-linear specification which allows estimated coefficients to be interpreted as elasticities.

Having used the ordinary least squares procedure to analyze the cross-section data, they concluded that estimates tend to corroborate previous empirical work. With the exception of the estimated coefficient of the probability of imprisonment, the coefficients of the law enforcement variables had the expected negative signs. However, only the estimated coefficients of the probabilities of arrest and conviction were statistically significant. Their values were -0.65 and -0.53 respectively (Cornwell & Trumbull 1994:363). When applying the two stage least squares procedure to the same data the estimated deterrent effects were very similar, except for those concerning the variable the probability of arrest. Cornwell and Trumbull, however, cautioned that the difference in the estimates of the probability of arrest may not be entirely attributable to simultaneity, but that unobservable heterogeneity may be present. They accounted for this by using panel data. When applying the ordinary least squares procedure to this data, they found that the absolute value of the estimated deterrent elasticities associated with the probabilities of arrest and conviction decreased by approximately forty five percent. The estimated coefficient of the probability of imprisonment had the correct sign and was statistically significant and the deterrent effect of the average prison sentence length was small and statistically insignificant. It is notable that the effects of the average weekly wage in manufacturing and the male population between the ages of 15 and 24 were only statistically significant in regressions that do account for unobserved heterogeneity. They conclude that '[t]he results of our empirical investigation indicate that unobserved county heterogeneity is statistically important in our sample' (Cornwell & Trumbull 1994:361). And 'that both labor [*sic*] market and law enforcement incentives matter (consistent with Grogger (1991))' (Cornwell and Trumbull 1994:365). They also used the two stage least squares procedure to analyze the panel data but rejected the results on efficiency grounds.¹

Although Cornwell and Trumbull (1994) critically assessed the preceding empirical research on the determinants of crime and provided additional insights, they still concentrated almost exclusively on the influence of law enforcement variables², that is the probability of punishment and the cost of the median sentence, on the crime rate. Their aim was to contribute to the existing deterrence literature, which is focused on the activities of the criminal justice system. As mentioned in Chapter Two on page 62, the

conventional focus on deterrence leads to increased criminal justice system expenditure in the face of increased crime. This policy has, however, not succeeded in reducing crime worldwide and therefore must be questioned. In Chapter Two an interdisciplinary theory of crime was advocated as an alternative approach to crime prevention. In terms of this extended theory, the economic theory of crime no longer suffers from the traditional limitations on its potential as a theory of crime causation. The economic model of crime is interpreted in its broadest sense and focuses, not only on law enforcement, but also on economic and socio-economic variables. It follows that the activities of numerous government agencies can now be considered in terms of their ability and effectiveness in preventing crime.

Some authors have adopted this interdisciplinary approach and consider economic and socio-economic variables as determinants of crime in their empirical work. For the purposes of this research a sample of such studies was reviewed. In some cases the authors' aim was to determine the relative importance of the different categories of independent variables, in others it was merely to test a specific hypothesis regarding the effect of economic and/or socio-economic variables on the crime rate. In all instances only aggregate level studies were considered, which attempted to explain, either the overall crime rate, or property or violent crime rates.³ Table 4.1 below provides more information regarding these studies.

Table 4.1: Important Features of Interdisciplinary Studies of Crime Determinants

	Howsen and Jarrel (1987)	Trumbull (1989)	LaFree et al. (1992)	Meera and Jayakumar (1995)	Box and Hale (1984)	Wong (1995)	DeFronzo (1983)	Norström (1988)	Bennett (1991)
Geographical Area	Kentucky counties	North Carolina counties	United States	Malaysia	England and Wales	England and Wales	United States SMSAs	Sweden	Different Countries
Data Type	cross-section	cross-section	time-series	time-series	time-series	time-series	cross-section	time-series	panel
Estimation Procedure	2SLS	OLS	OLS	2SLS	OLS	OLS	OLS	OLS	OLS
Functional Form	linear	linear	log-linear	linear	linear	log-linear	linear	log-linear	linear quadratic
Crime Type (reported crimes)	burglary larceny robbery	total crime	burglary robbery murder (<i>Black and White arrest rates</i>)	housebreaking motor theft total theft robbery murder rape aggravated assault total violent crime drug addiction total crime	shoplifting burglary general theft fraud handling stolen goods theft from employers robbery aggravated assault (<i>female conviction rates</i>)	total crime	larceny burglary motor theft robbery murder rape aggravated assault	theft committed by adults (<i>conviction rates for 1841 - 1913</i>)	total theft murder
Law Enforcement Variables:									
Probability of Punishment	✓	✓	✓	✓		✓			
Cost of the Sentence	✓	✓				✓			
Economic Variables:									
Income	✓	✓	✓	✓		✓	✓	✓	
Unemployment	✓	✓		✓		✓	✓	✓	
Education	✓	✓	✓			✓			✓
Age	✓	✓	✓	✓			✓	✓	✓
Race	✓	✓					✓		
Gender						✓			
Socio-Economic Variables:									
Economic Development	✓			✓				✓	✓
Family Instability	✓		✓						
Population Density	✓	✓		✓			✓		✓
Additional Variables	police density, tourism, poverty grant	police density, dummy variable - western and central counties	Household Activity Index (crime risk), CPI	police density, police development expenditure	birth rate, number of single women, police force's gender composition, conviction of males		Household Activity Index, poverty grant	dummy variables - changes in the law and statistical practices	per capita real GDP, rate of change in per capita real GDP (Quadratic Form too)

OLS - Ordinary Least Squares

2SLS - Two Stage Least Squares

SMSA - Standard Metropolitan Statistical Area

CPI - Consumer Price Index

* It should be noted that Trumbull's above study was included in Cornwell and Trumbull's summary of previous empirical analyses and therefore contributed to their conclusions. All other studies were not considered by them.

Table 4.1 clearly indicates various alternative means of conducting empirical analyses regarding crime determination from an interdisciplinary perspective. Cross-section, time-series or panel data may be used, depending on availability. Aggregate level studies generally make use of standard metropolitan statistical areas, counties or countries as the unit of analysis. Further it appears as if country data is used in time-series and panel data research designs, whereas the smaller units of analysis are used in cross-section studies. It must be borne in mind that cross-section data cannot account for unobserved heterogeneity. However, the other form of endogeneity, simultaneity, can always be accounted for by using two or three stage least squares estimation procedures. In the absence of simultaneity, the ordinary least squares procedure can be adopted. Linearity is assumed but this does allow for curvilinear models and therefore polynomial variables may be considered provided that there are statistical or substantive reasons for doing so. Log-linear transformations are applied when the elasticities of the crime rate with respect to the explanatory variables are required.

Arrest and conviction rates can be used instead of the reported crime rate, particularly when research is concerned with a specific sector of the population like women or black people. Numerous independent variables may be included in a study, some studies include variables from each of the different categories, whereas others focus on only two of the three categories of variables. In Table 4.1, the first four studies include all variable types (and are presented in ascending chronological order), the next two include law enforcement variables and economic variables⁴ and the last three do not include law enforcement variables. In each of the studies different variables were actually used as proxies for the variable named in Table 4.1. These proxy variables were all considered in Chapter Three, in order to inform the creation of the proxy variables considered in this study as possible determinants of the South African crime rate. The variables used in the various studies will be referred to specifically when the results of these studies are compared to the South African results.

The difficulties associated with collecting appropriate data to analyze South African crime causation were spelled out in Chapter Three on pages 85 to 90. This review of international literature concerning empirical crime research is reassuring as many of the

studies have proceeded with estimation on the basis of similar data to the set that was assembled for the purposes of this study. In fact compared to other studies, a large number of proxy variables are considered in this study. In addition, the best practice estimation procedures outlined in the international literature are largely replicable in the South African case. Once the South African model of the market for offences has been formally specified in the next section, the results of this study will be compared to those in the international literature.

4.3 SPECIFICATION OF THE MODEL

In order to correctly specify the South African model of the market for offences so as to achieve the primary objectives of this study, it is necessary to consider the interdisciplinary model of crime described in Figure 2.2 on page 75 in Chapter Two. Essentially it is a model of the supply of and demand for offences. According to Gujarati (1995:636-637), the model may be formally presented as follows:

Assuming that the demand and supply functions are linear:

$$\text{Demand function: } O_i^d = \alpha_0 + \alpha_1 r_i + v_{1i} \quad \alpha_1 < 0 \quad (4.1)$$

$$\text{Supply function: } O_i^s = \beta_0 + \beta_1 r_i + v_{2i} \quad \beta_1 > 0 \quad (4.2)$$

$$\text{Equilibrium condition: } O_i^d = O_i^s$$

where O^d = quantity of offences demanded

O^s = quantity of offences supplied

r = returns from criminal activities

v_i = error terms

i = observation

From the representation of the extended neoclassical model of crime on page 75 in Chapter Two and considering South African data availability, it is possible to specify these equations in more detail. Including only the variables for which there is reliable South African data, and leaving the rest to be reflected in the error term, equations 4.1 and 4.2 can be rewritten as follows⁵:

$$O_i^d = \alpha_0 - \alpha_1 p_i - \alpha_2 f_i + v_{1i} \quad (4.1')$$

$$O_i^s = \beta_0 + \beta_1 (d(w_i, w_i, C) - pf)_i + v_{2i} \quad (4.2')$$

$$O_i^s = \beta_0 + \beta_1 y_i + \beta_2 u_i + \beta_3 e_i - \beta_4 a_i + \beta_5 rc_i + \beta_6 g_i + \beta_7 b_i - \beta_8 i_i + \beta_9 fi_i + \beta_{10} pd_i - \beta_{11} p_i - \beta_{12} f_i + v_{2i} \quad (4.2'')$$

where p is the probability of punishment

f is cost of the median sentence

w_i is net earnings from illegitimate activities

w_i is earnings from legitimate activities net of costs

C is the cost of self protection and self insurance of potential victims

y is income

u is the unemployment rate

e is educational achievement

a is age

rc is race

g is gender

b is the benefit from illegitimate activities

i is industrialisation

fi is family instability

pd is population density

In terms of the order condition of identifiability⁶ (Gujarati 1995:664-665), the demand function is overidentified but the supply function is unidentified. This is a fundamental problem in that the numerical estimates of the parameters may not be reliable as different sets of coefficients may be compatible with the same data set (Gujarati 1995:657). Therefore simple ordinary least squares regression cannot be used to separately estimate equation 4.2'' (Gujarati 1995:658). Solutions to the system of simultaneous equations involve regressions applied to reduced-form equations, which express endogenous variables solely in terms of exogenous variables and disturbance terms. Hence, equations 4.3 and 4.4 below appear to be the relevant equations.

$$O_i^d = O_i^s$$

$$\alpha_0 - \alpha_1 p_i - \alpha_2 f_i + v_{1i} = \beta_0 + \beta_1 y_i + \beta_2 u_i + \beta_3 e_i - \beta_4 a_i + \beta_5 r c_i + \beta_6 g_i + \beta_7 b_i - \beta_8 i_i + \beta_9 f_i + \beta_{10} p d_i - \beta_{11} p_i - \beta_{12} f_i + v_{2i} \quad (4.1'=4.2'')$$

$$p_i = \Pi_0 + \Pi_1 y_i + \Pi_2 u_i + \Pi_3 e_i - \Pi_4 a_i + \Pi_5 r c_i + \Pi_6 g_i + \Pi_7 b_i - \Pi_8 i_i + \Pi_9 f_i + \Pi_{10} p d_i - \Pi_{11} f_i + q_i \quad (4.3)$$

$$O_i = \Pi_{12} + \Pi_{13} y_i + \Pi_{14} u_i + \Pi_{15} e_i - \Pi_{16} a_i + \Pi_{17} r c_i + \Pi_{18} g_i + \Pi_{19} b_i - \Pi_{20} i_i + \Pi_{21} f_i + \Pi_{22} p d_i - \Pi_{23} f_i + z_i \quad (4.4)$$

q_i and z_i are linear combinations of the original error terms v_1 and v_2 .

In equation 4.3 it is assumed that the probability of punishment is endogenous. This is acceptable and necessary as conventionally many researchers have made provision for the dependency of the probability of punishment on the crime rate.

Although reduced-form equations can be used to solve the simultaneous demand-and-supply equation system by applying least squares procedures, the unidentified supply equation makes estimators unreliable. Fortunately however as the main objective of this study is not to determine the equilibrium quantity of offences, return from criminal activities or probability of punishment, the above model is not applicable. The explicit objective of this study is to determine the relative importance of the various causes of South African crime and therefore, following most of the other researchers which take an interdisciplinary perspective, the appropriate method would be to regress the crime rate on many possible explanatory variables. Essentially this models, either the supply function or a "mongrel" equation' (Gujarati 1995: 659). That is, a hybrid equation incorporating the demand and supply equations. The supply equation and the mongrel equation are not easily distinguished as they include the same variables. But given that the data in this study relates to the overall market for crime in South Africa, it is most likely that the mongrel equation will be estimated.

By following the route of estimating this reduced-form equation, however, simultaneity is not avoided. It is necessary to consider that, of all the explanatory variables in this study, the probability of punishment is most likely endogenous. In the interdisciplinary studies reviewed only Howsen and Jarrel (1987) specified a probability of punishment equation. Trumbull (1989) did not find the probability of punishment dependent on the

crime rate and Cornwell and Trumbull (1994) used instrumental variables to overcome this dependency. Considering Howsen and Jarrel's endogenous function in terms of the South African situation, the following simultaneous equation system seems to be appropriate:

$$O_i = \Pi_0 + \Pi_1 y_i + \Pi_2 u_i + \Pi_3 e_i - \Pi_4 a_i + \Pi_5 r c_i + \Pi_6 g_i + \Pi_7 b_i - \Pi_8 i_i + \Pi_9 f i_i + \Pi_{10} p d_i - \Pi_{11} p_i - \Pi_{12} f_i + q_i \quad (4.5)$$

$$p_i = \Pi_{13} + \Pi_{14} O_i + \Pi_{15} T C_i + \Pi_{16} f_i + \Pi_{17} p d_i + \Pi_{18} r c_i + z_i \quad (4.6)$$

where TC is the overall crime rate, excluding the crimes included in O (the quantity of offences).

In terms of the order condition of identifiability, the crime rate function is exactly identified and the probability of punishment function is overidentified. This simultaneous equation system is therefore solvable using the two stage least squares estimation procedure, which is a single-equation method (Gujarati 1995:700). It is also appropriate that the specification be as general and all encompassing as possible because this study is multi disciplinary and the first attempted within the South African context and therefore includes a specific combination of explanatory variables not considered *per se* in any other empirical study. The specific combinations of explanatory variables that will be used to analyze total crime, violent crime and property crime as separate crime models were explained in Chapter Three on pages 93 to 99 when the pairwise correlation results were discussed. Although the resulting reduced-form equations are similar to those used in the interdisciplinary studies of crime described in Table 4.1 on page 108, they differ to some extent from every one of the these equations.

Considering the South African explanatory variables, the reduced-form equation system modelling total crime may be written as follows:

$$\begin{aligned} \text{totalcr}_i^* = & \Pi_0 - \Pi_1 \text{poor}_i + \Pi_2 \text{gini}_i + \Pi_3 \text{unex}_i + \Pi_4 \text{aveeduc}_i + \Pi_5 \text{sdeduc}_i - \Pi_6 \text{aveage}_i + \Pi_7 \text{age15}_i^* \\ & + \Pi_8 \text{bcpop}_i^* + \Pi_9 \text{bcaveinc}_i + \Pi_{10} \text{bc7ed}_i + \Pi_{11} \text{bcunnr}_i^* - \Pi_{12} \text{fempop}_i + \Pi_{13} \text{faveinc}_i \\ & + \Pi_{14} \text{faveeduc}_i + \Pi_{15} \text{funnr}_i + \Pi_{16} \text{momwork}_i + \Pi_{17} \text{medinc}_i + \Pi_{18} \text{bcmedinc}_i + \Pi_{19} \text{fmedinc}_i^* - \\ & \Pi_{20} \text{manuserv}_i + \Pi_{21} \text{femhh}_i + \Pi_{22} \text{urban}_i + \Pi_{23} \text{urban}_i^2 - \Pi_{24} \text{prob cort}_i - \Pi_{25} \text{avetime}_i + q_i \end{aligned} \quad (4.5')$$

$$\text{probcort}_i = \Pi_{26} - \Pi_{27}\text{totalcr}_i^* + \Pi_{28}\text{totalcr1}_i^* + \Pi_{29}\text{avetime}_i + \Pi_{30}\text{urban}_i + \Pi_{31}\text{urban}_i^2 + \Pi_{32}\text{bcpop}_i^* + \Pi_{33}\text{bcaveinc}_i + \Pi_{34}\text{bc7ed}_i + \Pi_{35}\text{bcunnr}_i^* + z_i \quad (4.6')$$

Table 4.2 below provides a list of the variables to be used in the estimation of equations 4.5' and 4.6'. The specific set of selected explanatory variables for total crime is taken directly from Table 3.2 on page 93 in Chapter Three.⁷ As noted in Chapter Three on pages 98 and 99 the sets of explanatory variables which will be used to model property crime and violent crime only differ in a few respects. In equations 4.5' and 4.6' the variables which are replaced by other variables are indicated with an asterix. In Tables 4.4, 4.6 and 4.7, respectively on pages 124, 141 and 150, where the regression results are reported, this exchange of variables will be evident. Also following the discussion in Chapter Three on page 95 a polynomial term, the square of the proportion of the population residing in an urban area, was included in the model. The scatter plots graphing the dependent variable relative to the explanatory variables do not indicate that any more polynomial terms need to be included. The dependent variables used were the total, violent and property crime rates.

Table 4.2: Proxy Variable Categories and Abbreviations

Variable Name	Proxy Variables
Quantity of Offences (O)	Total Crime Rate (totalcr) Violent Crime Rate (vioicr) Property Crime Rate (propcr)
Probability of Punishment (p)	Probability of Prosecution, given Crime (probcort)
Cost of the Sentence (f)	Average Length of Prison Sentence (avetime)
income (y)	Poverty-gap Index (poor) Gini Coefficient (gini)
Unemployment Rate (u)	Unemployment Rate (expanded definition) (unex)
Educational Achievement (e)	Average Number of Years of Education (aveeduc) Standard Deviation in Education Years (sdeduc)
Age (a)	Average Age (aveage) Proportion of Population Younger than 15 Years (age15) Proportion of Population between 16 and 25 Years (age16a25)
Race (rc)	Black and Coloured/Others Race Ratio (bcpop) Non-White/White Race Ratio (notwhpop) Black and Coloured/Others Ratio of Average Income (bcaveinc) Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed) Black and Coloured/Others Ratio of Unemployment (narrow definition) (bcunnr) Black and Coloured/Others Ratio of Unemployment (expanded definition) (bcunex)
Gender (g)	Female/Male Gender Ratio (fempop) Female Average Income (faveinc) Female Average Education Years (faveeduc) Female/Male Ratio of Unemployment Rate (narrow definition) (funnr) Proportion of Mothers that Work (momwork)
Benefit from Crime (b)	Median Income (medinc) Black and Coloured/Others Ratio of Median Income (bcmmedinc) Female Median Income (fmedinc) Female/Male Ratio of Median Income (fmmmedinc)
Economic Development / Industrialisation (I)	Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)
Family Instability (fi)	Proportion of Female Headed Households (femhh)
Population Density (pd)	Proportion of Population that Resides in Urban Area (urban)
Additional Crime Rate (TC)	Rate of Overall Crime per 100 000 people, excluding Overall Serious Crime (totalcr1) Rate of Overall Crime per 100 000 people, excluding Violent Crime (vioicr1) Rate of Overall Crime per 100 000 people, excluding Property Crime (propcr1)

To summarise, in order to achieve the objectives of this particular study the simultaneous equation system including equations 4.5' and 4.6' will be estimated. Owing to availability, the data set used is cross-sectional and relates to crime committed in ninety magisterial districts in South Africa in 1994. The two stage least squares procedure is appropriate to estimate the coefficients of the parameters of the equation system. Log-linear transformations will be considered as the elasticities of the crime rate with respect to the explanatory variables are necessary to determine the relative importance of the numerous variables in causing South African crime. As mentioned in the previous paragraph a polynomial term has been included, therefore the model also includes curvilinear transformations. This specification of the models is in line with those used in the studies reviewed in the international literature.

However before the actual regression analyses can be performed, some preliminary changes may need to be made to the data and/or the models to improve the results of the analyses. The statistics describing the variables in the models must be examined for irregularities. Multicollinearity between variables must be detected. The appropriate functional form for the models must be determined. It is also important to consider the distribution of each of the dependent variables in terms of normality. For this purpose a skewness-kurtosis test (Hamilton 1998:100-101) was used to evaluate the null hypothesis that the sample came from a normally distributed population. All of the dependent variables, totalcr, violcr and propcr, were significantly non-normal in skewness ($P=0.000$) and kurtosis ($P=0.000$). The assumption of normality is one of the least restrictive assumptions of a linear model, especially for large data sets. For the crime rate functions the assumption was violated and because of the large number of independent variables in this study (refer to page 110) relative to the size of the data set, it was necessary to transform the dependent variables using a Box-Cox transformation (Hamilton 1998:101-103) to satisfy the assumption. Now:

$$\begin{aligned} \text{totalcr} &= (\text{original totalcr}^{0.0497} - 1) / -0.0497 && 95 \text{ percent confidence interval: } -0.2097 < \lambda < 0.1138, \\ \text{violcr} &= (\text{original violcr}^{0.0390} - 1) / -0.0390 && 95 \text{ percent confidence interval: } -0.1826 < \lambda < 0.1091, \\ \text{propcr} &= (\text{original propcr}^{0.0423} - 1) / -0.0423 && 95 \text{ percent confidence interval: } -0.1937 < \lambda < 0.1126. \end{aligned}$$

In all cases the 95 percent confidence intervals reject the hypothesis that the best

transformation is no transformation ($\lambda=1$). Trumbull (1989:429) also adopted the Box-Cox approach.

As is the case with all socio-economic data, there are complex relationships between the variables in the data set owing to underlying trends. Although acknowledging that multicollinearity results in substantially higher standard errors and lower t-statistics, as well as unexpected changes in the magnitude and signs of coefficients, it was decided not to change the models by dropping or transforming any of the variables. This approach was also adopted in the empirical studies reviewed as there is no theoretical justification for doing so.

When considering the statistics describing the variables to be used in the analyses it was noted that ten variables had a substantial number of missing values⁸, they were: bcpop, notwhpop, bcmedinc, bcaveinc, bcunnr, bcunex, bc7ed, fmmedinc, funnr and manuserv. A decision had to be made concerning which of two possible methods should be used to derive imputed values to replace the missing values. Either stepwise regression should be used to determine the variable as a function of other variables in the equation system, or the data should be examined to determine whether any recalculations can be made which do not affect results too drastically.

Initially it was decided to use the first method as it would to some extent correct for the unrepresentativity of the data in some of the magisterial districts, although it would probably increase the multicollinearity within the data set. However when this method was applied, missing values were generated for some of the variables.⁹ Therefore as the aim of the exercise was defeated, it was decided to abandon this method in favour of the second. After exploring the data in order to ascertain the causes of the missing values, a number of recalculations were performed in order to impute values. Essentially the modifications that had to be made all relate to altering the way in which the statistical package which was used dealt with the mathematical problems relating to the number zero.¹⁰

In order to determine whether the missing observations have a significant impact on the regression analysis; it was decided to perform the regression analysis once without the variables which have missing values and then again including these variables, with the necessary imputed values. The regression analyses applying the total crime rate equations were then performed and the analysis using the imputed values is preferred. In both analyses stepwise regressions indicated that the determinants of the endogenous variable probcort were the same. Hausman specification tests determined that the two stage least squares estimation procedure was appropriate in both analyses. Although the *P*-values also yielded the same results, the other regression results were more favourable for the analysis including the imputed values. The R^2 and adjusted R^2 percentages were greater. Some of the variables previously excluded were significant according to the t-test. And some of the shared variables gained significance, although some lost significance. It was therefore decided to use the imputed values and therefore the additional variables in the model. It must also be remembered that there are important theoretical reasons providing a bias towards the inclusion of these variables.

Ideally for the purposes of this research log-linear models should be used. Determining the elasticities of the crime rate with respect to the numerous causal variables in each crime model is necessary in order to inform appropriate crime prevention policy. For this reason log-linear transformations were adopted when applying the two stage least squares procedure to estimate the total crime model. However when the logs of the variables were calculated, twelve variables have missing values¹¹ and had to be excluded from the model. The results of this constant elasticity model were then compared to those of the unlogged model, after having excluded the twelve variables.

According to Gujarati (1995:168), these two models cannot be compared by considering the R^2 or any other regression output directly. However, one way to compare the models is to calculate the elasticities of the unlogged model with respect to the explanatory variables by using their means, the estimates of the slope from the regression and the mean value of the dependent variable.¹² The results of these calculations should then be compared to the coefficients estimated using the log-linear model. If the two results are similar, the log-linear model may be used with confidence. In this case the results

were notably dissimilar and it was concluded that the log-linear model yielded results which were not reliable enough. Because of this and the necessity of dropping many variables from the model, as the logging procedure generated missing values, it was decided to discontinue the use of log-linear models. However as estimating elasticities remains desirable in terms of economic theory, it was decided to estimate linear models but then to calculate the elasticities, essentially constructing curvilinear models, in order to facilitate their interpretation.

In this study the methodology employed in the estimation of all three models of crime was standardised. Obviously, the total crime model is the most important of the three and it was therefore used to make decisions concerning the procedures above and the estimation procedure to be adopted. The property crime rate equation and the violent crime rate equation were dealt with accordingly.

4.4 ESTIMATION OF THE MODELS

Table D.1 describing the summary statistics of the model variables can be found in Appendix D on page 264. Having taken the above changes into account, it was possible to proceed with the regression analyses. The first step in the regression analyses, was to ascertain the determinants of the endogenous variable the probability of prosecution in South Africa. For this purpose stepwise regressions using a process of backward elimination were performed.¹³ The variables that were significant at the 0.05 level resembled those in the probability of punishment functions specified similarly to the one used by Howsen and Jarrel (equations 4.6 and 4.6') closely. The results of the stepwise regressions are given in the table below. From these it appears as if the probability of prosecution is an endogenous variable within the crime rate equation in the South African context, as it is determined by explanatory variables in the crime equation and by the crime rate itself.

Table 4.3: Stepwise Regression Results Relating to the Probability of Prosecution

	<u>Total Crime</u>	<u>Property Crime</u>	<u>Violent Crime</u>
intercept	+32.00131 (7.870)***	+24.41152 (7.429)***	+18.424 (6.443)***
totalcr	-5.034578 (-8.772)***		
violcr			-3.37398 (-7.136)***
propcr		-3.971432 (-8.083)***	
avetime	+0.2683464 (2.014)**	+0.3186713 (2.319)**	
totalcr1	+0.0071848 (4.361)***		
violcr1			+0.0001075 (3.136)***
propcr1		+0.0002203 (3.674)***	
faveinc	+0.0000294 (2.641)***	+0.0000262 (2.269)**	
femhh	+4.219285 (2.195)**		
aveeduc	+0.8367047 (3.971)***	+0.4639109 (2.773)***	+0.7365728 (4.441)***
manuserv	-3.65e-08 (-2.467)**		
urban	-9.007301 (-3.045)***		
urban ²	+5.539679 (2.165)**		
N	90	90	90
R ²	0.6176	0.5616	0.4804
Adjusted R ²	0.5746	0.5355	0.4622
Prob > F	0.0000	0.0000	0.0000

* T-statistics are in parenthesis. Significance at $\alpha = 0.01, 0.05$ and 0.10 are indicated by ***, ** and * respectively.

Essentially the categories of variables that Howsen and Jarrel included as determinants of the probability of punishment are also important determinants in South Africa. However, in South Africa the race variables do not appear to be important determinants of the probability of prosecution but average educational attainment does. The average income earned by women is also significant in the total and property crime models. In the total crime model the variables relating to family stability and economic development are also significant.

The signs on the estimated coefficients are explicable in terms of Howsen and Jarrel's reasoning (1987:449-451). The negative signs on the crime rate parameters are an indication of the inability of particularly the police force to combat increasing crime. The

positive signs on the additional crime rate parameters result because of increased police effort to solve more crimes as crime increases. It must be borne in mind that in all the above cases the additional crime rates exclude major South African crime categories. The positive signs on the severity of punishment parameters reaffirm that police effort is positively related to the severity of punishment. The negative sign on the population density parameter reflects the increased difficulty in identifying criminals as populations become more dense. Regarding the variables not considered by Howsen and Jarrel, it appears as if the positive signs on the income and education parameters indicate a positive relationship between the average level of education and income in an area and the probability of criminals being prosecuted. The proportion of female headed household is positively related the probability of being prosecuted, probably because these households are poorer and more unconventional and are therefore focussed on by the criminal justice system. The ratio of workers in manufacturing to service industry workers is negatively related the probability of prosecution, implying that as development occurs the probability increases.

The variables indicated in each of the crime models in Table 4.3 above replace those in the probability of prosecution equation represented as equation 4.6'. These specific variables have been statistically identified as important determinants of the probability of prosecution in South Africa and therefore they necessarily replace the generic variables in equation 4.6'. Following the other empirical studies reviewed, the probability of prosecution equations relating to the three crime models will not be discussed in greater detail. The determinants of the probability of prosecution in South Africa have been identified and are theoretically justifiable. They may therefore be included in the reduced-form equation systems modelling crime. Importantly for the purposes of this study, it has been established that the probability of prosecution is probably an endogenous regressor in the crime rate equation. As the focus in this study is on crime causation, the crime rate equation is central to the analysis and the probability of prosecution equation is therefore considered to be ancillary.

Having assessed the probability of prosecution equations, the next step was to establish whether, in fact, there is simultaneity in the equation systems. For each of the crime

models a Hausman specification test was performed (Gujarati 1995:670-672, Pindyck & Rubinfeld 1991:303-305). This was necessary because if there is no simultaneity and two stage least squares estimation procedures are adopted, estimators are consistent but inefficient (Gujarati 1995:670, Pindyck & Rubinfeld 1991:303). The Hausman procedure essentially tests whether or not an endogenous variable is correlated with the disturbance term in the equation. If this is true, simultaneity exists. In order to determine this, the ordinary least squares procedure is used to estimate the endogenous variable as a function of all the exogenous variables in the equation system (reduced-form equation) and the predicted values and the residuals are calculated from this. The system equation is then estimated using ordinary least squares. However, the predicted values of the endogenous regressor, instead of the actual values, are used and the residuals are included as an additional variable. A t-test is then performed on the coefficient of the residual variable and if it is significant the hypothesis of simultaneity cannot be rejected.

Following the above procedure, the Hausman specification test was applied to each of the three crime models to ascertain whether the probability of prosecution variable, which is believed to be endogenous, was related to the disturbance term in crime rate equation. The details of the Hausman procedure relating to each of the crime models are presented in Appendix E on page 265. The results of the t-tests performed were the same, $P > |t| = 0.000$. Accordingly, it was established with a 99 percent level of confidence that simultaneity cannot be rejected in any of the models. Given the simultaneity in the equation systems, the two stage least squares estimation procedure was performed for each crime model.

The two stage least squares estimation procedure eliminates the correlation between the endogenous regressor and the disturbance term by introducing an instrumental variable into the system. In the first stage the endogenous variable is estimated as a function of all the exogenous variables (reduced-form equation) in the equation system using the ordinary least squares procedure. The predicted values of the endogenous variable are then used in the second stage to estimate the system equation, also using the ordinary least squares procedure. The first stage of this procedure is identical to step

one of the Hausman specification test and the details relating to each of the crime models are given in Appendix E on page 265. Table 4.4 below provides the two stage least squares regression results relating to the crime rate equation in each of the crime models. The results indicated in the Violent Crime (2) column should be ignored at this stage as they will be discussed later in this section.

Table 4.4: Two Stage Least Squares Results for the Crime Rate Equation

	<u>Total Crime</u>	<u>Property Crime</u>	<u>Violent Crime</u>	<u>Violent Crime(2)</u>
intercept	+3.97036 (2.042)**	-1.236745 (-0.754)	-2.843022 (-1.523)	(-0.410)
endogenous probcort	-0.6832578 (-7.510)***	-0.8732212 (-7.414)***	-0.9020247 (-6.819)***	(-1.909)*
avetime	+0.2097335 (5.203)***	+0.3455443 (6.027)***	+0.35738 (5.506)***	(1.290)
poor	-2.43713 (-3.103)***	-2.434606 (-2.860)***	-2.671554 (-2.839)***	(-0.715)
gini	+0.54127 (0.832)	-1.316151 (-1.596)	-0.6729531 (-0.739)	(-0.191)
unex	-0.0257757 (-3.154)***	-0.0395223 (-3.712)***	-0.0359147 (-3.428)***	(-0.893)
aveeduc	+0.6508699 (2.259)**	+1.12447 (3.614)***	+1.150631 (3.347)***	(0.910)
sdeduc	+0.7106444 (3.253)***	+0.8368251 (3.508)***	+0.849773 (3.149)***	(0.761)
aveage	+0.0567004 (1.517)	+0.1271866 (3.429)***	+0.1377815 (3.266)***	(0.678)
age15	-6.400625 (-2.644)***			
age16a25		-5.252979 (-2.372)**	-5.22035 (-2.105)**	(-0.623)
bcpop	+2.22e-10 (1.490)			
notwhpop		+1.43e-10 (1.274)	+2.01e-10 (1.619)	(0.534)
bcaveinc	+3.95e-15 (3.202)***	+5.14e-15 (3.922)***	+5.06e-15 (3.498)***	(1.095)
bc7ed	+6.68e-08 (1.687)*	+1.65e-07 (4.048)***	+1.91e-07 (4.200)***	(1.567)
bcunnr	-1.44e-09 (-1.850)*		-4.92e-10 (-0.548)	(-0.155)
bcunex		+1.30e-09 (2.129)**		
fempop	+1.38103 (2.420)**	+1.564322 (2.553)**	+1.904135 (2.790)***	(0.848)
faveinc	+0.0000185 (5.913)***	+0.0000249 (6.334)***	+0.0000246 (5.892)***	(0.926)
faveeduc	-0.7597018 (-2.640)***	-0.9151796 (-3.018)***	-0.9510747 (-2.814)***	(-0.764)
funnr	-5.43e-09 (-2.563)**	-7.98e-09 (-3.357)***	-8.29e-09 (-3.207)***	(-0.992)
momwork	+1.432943 (2.081)**	+2.560821 (3.173)***	+2.408234 (2.652)***	(0.584)
medinc	+0.0004414 (1.800)*	-0.0001194 (-0.428)	+0.0000973 (0.334)	(0.060)
bcmedinc	+1.99e-10 (2.384)**	+2.25e-10 (2.447)**	+2.74e-10 (2.633)**	(0.654)
fmedinc	-0.0002766 (-0.706)			
fmmedinc		-8.33e-09 (-4.229)***	-8.11e-09 (-3.743)***	(-1.072)
manuserv	-8.65e-09 (-2.955)***	-1.23e-08 (-3.581)***	-1.30e-08 (-3.374)***	(-0.986)
femhh	+3.881757 (4.344)***	+5.094734 (4.671)***	+5.460784 (4.424)***	(0.914)
urban	-2.179141 (-3.033)***	-3.26417 (-4.066)***	-3.303268 (-3.644)***	(-0.781)
urban ²	+1.770142 (2.788)***	+2.207829 (3.278)***	+2.203372 (2.904)***	(0.578)
N	90	90	90	90
R ²	0.6678	0.6912	0.6762	.
Adjusted R ²	0.5380	0.5706	0.5498	.
Prob > F	0.0000	0.0000	0.0000	0.9458

* T-statistics are in parenthesis. Significance at $\alpha = 0.01, 0.05$ and 0.10 are indicated by ***, ** and * respectively.

Diagnostic analyses had to be performed on the models. Firstly, it was necessary to consider the residuals of the regressions. In all the models the residuals were plotted against the predicted values and it was found that the residuals were, neither predominantly positive, nor predominantly negative. Graphical plots of the residuals of all the models suggest normal distributions, however, skewness-kurtosis tests were performed to evaluate this formally (Hamilton 1998:100-101). In all cases, with a 95 percent level of confidence, the null hypothesis of normality could not be rejected. In the total crime model normality was indicated in the skewness ($P=0.033$) and kurtosis ($P=0.802$) statistics. This was also evident in the property crime model, where for the skewness statistic $P=0.024$ and the kurtosis statistic $P=0.466$, and the violent crime model, where $P=0.051$ and $P=0.548$ respectively. The mean value of the residuals was also considered in order to determine whether or not it approximated zero. This was found to be the case in all three models. In the total crime model the mean of the residuals was $2.17e-09$, in the violent crime model the figure was $-1.87e-09$ and in the property crime model $-3.95e-10$.

Finally, it had to be determined whether heteroscedasticity was present in the models. An informal method of detecting heteroscedasticity is to plot the squared residuals of each regression against the predicted value for the dependent variable, in order to see whether or not any systematic pattern between the two variables can be identified (Gujarati 1995:368-369). In all three models no systematic pattern was detected when considering these graphical plots and therefore heteroscedasticity did not appear to be a problem. Cook-Weisberg tests for heteroscedasticity (Hamilton 1998:169), which use squared standardised residuals, were performed to assess this formally. It was found that with a 95 percent level of confidence, the null hypothesis of constant error variance could not be rejected in the total crime model ($\text{Prob}>\chi^2=0.4037$) and the property crime model ($\text{Prob}>\chi^2=0.0559$). However, the null hypothesis was rejected for the violent crime model as $\text{Prob}>\chi^2=0.0484$. The White method was used to correct for heteroscedasticity in this model and the resultant t-statistics and significance levels are reflected in Table 4.4 on page 124 in the far right hand column.

Now considering the violent crime model it is evident that it is not robust as the P -value is high, indicating that the null hypothesis that the estimated coefficients of all the parameters are zero cannot be rejected, and the R^2 is not determined. The variable *probcort* is the only significant variable at the 90 percent confidence level. Given this the results of this model must be considered unreliable, however the violent crime model will be included in the analysis. As mentioned in Chapter One on page 43 violent crime is very prevalent in South Africa and it is necessary to comment on the possible causes of this crime, although acknowledging that the model merits further research. It must also be remembered from Chapter Two on pages 55 and 56 that the economic model of the market for offences is based on the assumption that criminals act rationally. However this assumption of rationality has been challenged by other social scientists, who argue that the economic theory of crime is not appropriate for analyzing emotionally motivated crimes. Therefore, the fact that an interdisciplinary model of violent crime using the economic theory of crime as the relevant paradigm does not hold up to rigorous empirical modelling should not be completely unexpected.

4.5 INTERPRETATION OF RESULTS AND COMPARISON WITH OTHER STUDIES

In Chapter Three on pages 93 to 99 the preliminary empirical analyses regarding total crime, property crime and violent crime were discussed. The Pearson pairwise correlations between various law enforcement, economic and socio-economic variables and the crime rates were considered and interpreted. In this chapter the analyses are more sophisticated, empirical models were developed to formally assess the causes of the various categories of crime in South Africa. Whereas the Pearson pairwise correlations between the explanatory variables and each of the crime rate variables focussed exclusively on the direct expected effect of the explanatory variable on the crime rate, this is not the case with the crime models which allow for other interrelationships. Consequently in some instances the results of the formal models differ from the correlation results, however, they should still be explicable in terms of the interdisciplinary theory of crime. It is therefore necessary to refer back to Table 2.1 on page 73 in Chapter Two, which indicates the hypothesised relationships between the economic and socio-economic variables and the crime rate and the reasons for this, to

facilitate the interpretation of the results of the formal models. It should be remembered that the effects of these variables on the crime rate are more often than not contradictory and therefore care must be taken in interpreting the empirical results. The use of reduced-form crime models necessarily presupposes that only the net effect of explanatory variables on the crime rate will be manifest. Figure 2.2 on page 75 represents the entire model of the market for crime, including the law enforcement variables and should also be considered.

In order to meaningfully interpret the results of the crime models it is also essential to compare them with those obtained in other studies. Although it is acknowledged that in some cases "the consistency of findings might be an artifact of a similarity in method rather than evidence of a "scientific law" based on a preponderance of observations" (Popper by Bennett 1991:344). To make the comparison easier, the results of all the studies reviewed are included with the findings of this research in tabular form. Separate tables have been constructed for the three crime categories of interest in this study and they will each be discussed individually. Accordingly the information from the surveyed literature has been disaggregated and is reflected in the appropriate place.

It should be noted that for each study only the final model results are shown. The particular crime(s) in each study that are included within the overall crime, property crime or violent crime category are not specifically mentioned unless the results differ from those of the other crimes in the study. They are, however, mentioned individually when reporting the R^2 and adjusted R^2 statistics. Table 4.1 on page 108 may also be consulted for a list of the crimes analyzed by author. From Chapter One on page 42 it should be remembered that robbery is included in both the subcategories property crime and violent crime. DeFronzo (1983) and LaFree (1992) both estimate two equations. DeFronzo uses the income level variable in one and the income inequality variable in the other. LaFree estimates one equation for the Black population and another for the White population. Therefore the numbers given in the summary of results columns do not always add up directly. Each time a variable within a particular variable category was tested, whether more than once in one equation, or in more than one equation, the result was indicated in the result summary of that variable category. In cases where the

variable tested in other research is inversely related to the variable considered in this study, the result was switched to reflect the expected outcome of the variable considered in this study.

Firstly the total crime model will be discussed, thereafter the property crime model and finally the violent crime model. Table 4.5 below contains the results of all the studies that considered the total crime rate, including this one. The variables indicated in the Variables column are those that were used in the current study.

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Table 4.5: Regression Results for the Total Crime Rate

Variables	Trumbull (1989)	Cornwell and Trumbull (1994)	Meera and Jayakumar (1995)
Probability of Prosecution, given Crime (probcort)	Probability of Arrest, given Crime Probability of Conviction, given Arrest Probability of Imprisonment, given Conviction <i>All Negative , All Significant</i>	Probability of Arrest, given Crime Probability of Conviction, given Arrest Probability of Imprisonment, given Conviction <i>All Negative , All Significant</i>	Prison Overcrowding Factor (Inversely Related to the Probability of Imprisonment) <i>Positive , Significant</i>
Average Length of Prison Sentence (avetime)	Average Prison Sentence Length <i>Negative , Significant</i>	Average Prison Sentence Length <i>Negative</i>	
Poverty-gap Index (poor)	Per Capita Income <i>Negative</i>	Average Weekly Wage in: Construction <i>Negative</i> Transport and Telecommunications <i>Positive</i> Wholesale and Retail Trade <i>Negative</i> Finance, Insurance and Real Estate <i>Negative</i> Services <i>Positive</i> Manufacturing <i>Negative , Significant</i> Federal Government <i>Negative</i> State Government <i>Positive</i> Local Government <i>Positive</i>	
Gini Coefficient (gini)			Urban - Rural Income Disparity <i>Negative</i>
Unemployment Rate (expanded definition) (unex)	Unemployment Rate <i>Negative , Significant</i>		Unemployment Rate <i>Positive , Significant</i>
Average Number of Years of Education (aveeduc)			
Standard Deviation in Education Years (sdeduc)	Proportion of Population who have 12 Years of Education <i>Positive</i>		
Average Age (aveage)			
Proportion of Population Younger than 15 Years (age15)	Proportion of Population between the Ages of 15 and 24 <i>Negative</i>	Percentage of Male Population between the Ages of 15 and 24 <i>Positive , Significant</i>	Percentage of Population between the Ages of 15 and 29 <i>Negative</i>
Black and Coloured/Others Race Ratio (bcpop)	Proportion of the Population that is White (Inversely Related to Black Proportion) <i>Negative , Significant</i>		
Black and Coloured /Others Ratio of Average Income (bcaveinc)			

Table 4.5 continued

Variables	Wong (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Probability of Prosecution, given Crime (probcort)	Probability of Conviction, given Crime <i>Negative , Significant [4]</i>	zero	eleven	zero	negative, significant
Average Length of Prison Sentence (avetime)	Average Prison Sentence Length <i>Negative , Significant [4]</i>	zero	five	one	positive, significant
Poverty-gap Index (poor)	Real Wage Index of Workmen of Unchanged Grade <i>Negative , Significant [3]</i>	zero	four	ten	negative, significant
Gini Coefficient (gini)		zero	zero	one	positive, insignificant
Unemployment Rate (expanded definition) (unex)	Unemployment Rate <i>Positive , Significant [4]</i>	five	one	zero	negative, significant
Average Number of Years of Education (aveeduc)	Effect of 1870 Elementary Education Act <i>Negative , Significant [1]</i>	zero	one	one	positive, significant
Standard Deviation in Education Years (sdeduc)	Per Capita Primary School Enrolment Rate <i>Negative</i>	zero	zero	three	positive, significant
Average Age (aveage)		zero	zero	zero	positive, insignificant
Proportion of Population Younger than 15 Years (age15)		one	zero	two	negative, significant
Black and Coloured/Others Race Ratio (bcpop)		zero	one	zero	positive, insignificant
Black and Coloured /Others Ratio of Average Income (bcaveinc)		zero	zero	zero	positive, significant

Table 4.5 continued

Variables	Trumbull (1989)	Cornwell and Trumbull (1994)	Meera and Jayakumar (1995)
Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed)			
Black and Coloured/Others Ratio of Unemployment (narrow definition) (bcunnr)			
Female/Male Gender Ratio (fempop)			
Female Average Income (faveinc)			
Female Average Education Years (faveeduc)			
Female/Male Ratio of Unemployment Rate (narrow definition) (funnr)			
Proportion of Mothers that Work (momwork)			
Median income (medinc)			
Black and Coloured/Others Ratio of Median Income (bcmedinc)			
Female Median Income (fmedinc)			
Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)			Per Capita GNP (Inversely Related) Positive, Significant
Proportion of Female Headed Households (femhh)			
Proportion of Population that Resides in Urban area (urban)	Population per Square Mile Positive, Significant Dummy Variable - Urban Counties Negative, Significant	Population Density Positive	Urbanisation Index Positive, Significant Population Size Negative
(urban) ²			
Additional Variables	Police Density Positive, Significant Dummy Variable - Western and Central Counties All Negative, All Significant	Police Density Positive	Police Density Negative Per Capita Police Development Expenditure Positive
Adjusted R ²	0.8045	Not Given	
R ²			0.94

Table 4.5 continued

Variables	Wong (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed)		zero	zero	zero	positive, significant
Black and Coloured/Others Ratio of Unemployment (narrow definition) (bcunnr)		zero	zero	zero	negative, significant
Female/Male Gender Ratio (fempop)		zero	zero	zero	positive, significant
Female Average Income (faveinc)		zero	zero	zero	positive, significant
Female Average Education Years (faveeduc)		zero	zero	zero	negative, significant
Female/Male Ratio of Unemployment Rate (narrow definition) (funnr)		zero	zero	zero	negative, significant
Proportion of Mothers that Work (momwork)		zero	zero	zero	positive, significant
Median Income (medinc)	Real Per Capita Net National Income <i>Positive</i> Real Wage Index for All Workers <i>Positive</i>	zero	zero	four	positive, significant
Black and Coloured/Others Ratio of Median Income (bcmedinc)		zero	zero	zero	positive, significant
Female Median Income (fmedinc)		zero	zero	zero	negative, insignificant
Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)		zero	one	zero	negative, significant
Proportion of Female Headed Households (femhh)		zero	zero	zero	positive, significant
Proportion of Population that Resides in Urban area (urban)		two	one	two	negative, significant
(urban) ²		zero	zero	zero	positive, significant
Additional Variables					
Adjusted R ²					
R ²	0.7380 - 0.7933 [4]				

The following variables are all negatively related to the total crime rate: probcort, poor, bcunnr, funnr, faveeduc and manuserv. In all instances these results correspond with the majority of the findings in other studies, except where variables were not tested in any of the other studies. These results also coincide with the results obtained in the preliminary analysis. The conclusions drawn regarding these variables in Chapter Three on pages 93 to 97 will be mentioned again briefly. The probability of prosecution given crime is a deterrent to crime in South Africa. The poverty-gap index is a good indicator of the potential earnings from legitimate employment because when the poverty-gap increases, crime increases. Thus poverty in South Africa does cause crime as was suggested in Chapter One on page 9. The negative relationship between the Black and Coloured to Others ratio of the unemployment rate and the female to male ratio of the unemployment rate and the total crime rate appears to indicate that unemployment is important in determining business related crimes. For women education is a deterrent to crime. Economic development, which decreases the ratio of workers in manufacturing to service industry workers, increases crime.

Also as indicated in the preliminary analysis in Chapter Three on page 93, the following variables are positively related to the total crime rate; medinc and bcmedinc. These findings could not be compared as these variables were not tested in any of the other studies of total crime. However, in the property and violent crime models median income is positively related to crime in the majority of studies reviewed. Median income, including that of the Black and Coloured population, is an indicator of the potential earnings from undertaking criminal activities and is therefore expected to be positively related to the crime rate. A F-test was performed on the two general income variables poor and medinc, which consider the returns from legitimate and illegitimate activities respectively, to see if they have a collective influence on the total crime rate. The F-test tests the joint null hypothesis that all the variables in the subset taken together make no contribution towards explaining the dependant variable. The null hypothesis was rejected as it was determined with a 99 percent level of confidence that these variables do influence the total crime rate ($\text{Prob}>F=0.0018$).

Given that the variable *manuserv* indicates that economic development fosters crime and that the two income variables indicate that crime increases when the income of the working population and poverty increase, the conclusions of Norström (1988) and LaFree et al. (1992) must be mentioned. Both found that their studies verified that there was a marginalised group in society that did not have access to the opportunities provided by economic development and therefore turned to crime. As mentioned in Chapter Two on page 69 many of the non-economic theories of crime are concerned with the lack of "access to conventional opportunities" as a crime determinant. In economic terms, the trickle-down effect must not be assumed to accompany economic development. The South African crime situation appears to bear testimony to this.

The variables *unex* and *urban* have negative signs on their estimation coefficients and there is a positive sign on the estimation coefficient of the variable *bopop*. All these variables have signs which correspond with the findings in the preliminary analysis in Chapter Three on page 93. However, in all cases these results do not correspond with the majority of the findings in other studies reviewed. The Black and Coloured to Others race ratio is positively related to crime but is not significant. Although this does not concur with the majority of results in the other total crime research, it does concur with the results from research on property and violent crimes. Once again the explanations for these relationships provided in Chapter Three on pages 93 to 97 will be mentioned.

The variable *unex* is a measure of the probability of acquiring legitimate employment and its negative relationship to crime seems to imply that business related crimes specifically are influenced by the unemployment rate. This was also indicated by the race and gender unemployment variables *bcunnr* and *funnr*. In the study conducted by Trumbull the unemployment rate was also negatively related to total crime and significant, however, he concluded that the unemployment rate was probably not a good measure of the potential earnings from legitimate employment (1989:429). It should be noted that most of the authors of the studies reviewed did not consider as many theories as were included within the interdisciplinary framework in this study. Trumbull (1989) did not consider the opportunity and radical criminology theories relating to crime committed within businesses.

The proportion of the population residing in an urban area is negatively related to crime. As mentioned in Chapter Three on page 95 Howsen and Jarrel (1987:454-455) postulated that the relationship between population density, caused by urbanisation, and the crime rate is negative at first and then positive. The hypothesised U-shaped relationship between urbanisation and the crime rate is supported in this study:

$$\text{totalcr} = 3.97036 - 2.179141 \text{ urban} + 1.770142 \text{ urban}^2.$$

¹⁴ Trumbull (1989:429) also found urbanisation to be significant and negatively related to total crime and reported that this seemed odd but provided no theoretical explanation.

The following variables all have positive signs on their estimation coefficients, whereas the Pearson pairwise correlation coefficients relating to these variables were in fact negative; gini, aveeduc, sdeduc, bcaveinc, bc7ed, faveinc, momwork and femhh. However, the positive relationships between these variables and the total crime rate are explicable in terms of the interdisciplinary theory developed in Chapter Two of this study on pages 64 to 76. It should be noted that the variable gini is not a significant determinant of crime in South Africa. And that the results obtained in this study could not be compared as these variables were not tested in other studies, except the variable aveeduc. In the majority of other empirical research aveeduc was not significant and positively related to total crime. Yet in the articles reviewed concerning property crime the level of education variables were most often positive and significant and in the violent crime articles an equal number of significant variables were positive and negative.

The Gini coefficient is a measure of income inequality and is in fact expected to be positively related to crime. The relatively low socio-economic status of a particular group in society restricts their "access to conventional opportunities", which encourages them to pursue crime. From the results given above for the variables manuserv, poor and medinc, this appears to be the situation in South Africa. In this study for each factor influencing crime, inequality and level measures were estimated where possible. This was not done in most of the other research reviewed and this study therefore includes many more variables than the others. It is therefore necessary to conduct F-tests on all these variable subsets in order to ensure that the variables in the subset influence crime

and that the joint null hypothesis that the subset variables collectively make no contribution towards explaining the crime rate can be rejected. The F-test was performed on the income variable subset containing poor, medinc and gini and it was determined that this entire subset does influence the total crime rate, with a 99 percent level of confidence ($\text{Prob}>F=0.0048$).

Standard deviation in education years is also an indicator of inequality, in education. Once again this variable is expected to be positively related to the total crime rate. Contrary to the findings in Chapter Three on page 94, greater inequality in income and educational attainment results in crime. Average number of years of education is also positively related to crime and it therefore appears that education is not a deterrent to crime but encourages business related crime. However, the level of education must be considered before a final conclusion can be drawn. From the summary statistics of aveeduc in Appendix D on page 264 it is apparent that the average level of education is low. And from the Pearson pairwise correlation results in Appendix B on page 255¹⁵ it is evident that education is only a crime deterrent beyond the primary school level. This level has not yet been attained on average in South Africa and although it does not appear so, education is most likely a deterrent to crime. Trumbull (1989:431) and LaFree et al. (1992:176) also suggest that the education level may be a proxy for the expected returns from undertaking criminal activities, as income generally increases with education, and may therefore be positively related to crime. A F-test was conducted on the education variables aveeduc and sdeduc and it was determined with a 99 percent level of confidence that they do influence the crime rate ($\text{Prob}>F=0.0009$).

The Black and Coloured to Others ratios of average income and proportion with primary school education are positively related to total crime in South Africa. This seems to indicate that they are important determinants of business related crime. However, as education does not appear to be a crime deterrent at such low levels it must be noted that education may not be related to crime committed in businesses. As indicated in Chapter One on page 37, the intention of this research is not to test any particular theory but it is necessary to have a general understanding of how race influences crime in South Africa. Initially it was decided not to construct an index that is an amalgam of the

many race indicators as it was not clear how this would be achieved in order to facilitate accurate interpretation. It was therefore necessary to perform the F-test on the race variable subset. During the process of this test the variables bcpop, bcaveinc and bcmedinc were dropped but it was established that bc7ed and bcunnr are dominant influences on total crime in South Africa, with a 95 percent level of confidence ($\text{Prob}>F=0.0381$). As bcunnr is related to business crimes and the effect of bc7ed is uncertain, it is not possible to state whether or not the emancipation hypothesis completely explains the impact of race on crime. The marginalisation hypothesis may be applicable to the education variable bc7ed.

The positive sign on the estimation coefficient of femhh is expected in terms of an interdisciplinary theory of crime. Female headed households are an indication of family instability. 'The fragmentation of families and of community life has removed a key aspect of human interaction, and thus of social stability. It has contributed to the loss of respect for life, dignity and property rights, and has destroyed hope. All of these factors contribute to criminal behaviour' (South Africa Foundation 1996:37). The proportion of mothers that work should be positively related to crime, according to Hagen's theory explained on page 94 in Chapter Three. Mothers that work are not present to supervise the activities of their children. As female average income is positively related to crime, this variable is important in determining crime committed in businesses.

Contrary to the findings in Chapter Three on page 93, the following variables are also positively related to the total crime rate but their relationship with crime is not explicable in terms of the interdisciplinary theory developed in Chapter Two; avetime, aveage and fempop. The signs on the estimation coefficients of the variables aveage and fempop could not be compared as other studies did not include these variables. The variable avetime was included in other total crime studies but the general deterrence results do not concur with the outcome of this study. However Howsen and Jarrel found that the average prison sentence was positively related to certain violent and property crimes, although these results were not significant. They emphasise that there are measurement problems regarding this variable, owing to concurrent sentencing and conditional sentence reductions (Howsen & Jarrel 1987:452).

The positive relationship between average length of prison sentence and the total crime rate may be related at an individual level to the experiences of certain long-term prisoners who forge criminal associations while in incarceration and encounter increased social resentment and stigmatisation upon release. However at an aggregate level the average length of prison sentences may not be a good indicator of the magnitude of punishment but may, in fact, be a proxy for the seriousness of crimes committed. Thus in areas where the crime rate is high, more serious crimes are committed. It should be remembered from Chapter Two on page 58 that the supply of offences is a positive function of the net benefit derived from criminal activity.

The variable fempop is positively related to South African crime. The female to male gender ratio is generally expected to be negatively related to crime as most crime is committed by men. Yet the possibility must be considered that the gender ratio may be positively related to crime because it is an indicator of the number of female headed households and is therefore a family instability proxy.

The variable aveage is an insignificant positive determinant of crime. Age should be negatively related to crime if, as is assumed in most theories, the majority of crime is committed by youths. However, in South Africa this does not appear to be the case. '[T]he models developed for crime in particular societies may not naturally extend to other societies ... some of the societal variables may need to be reinterpreted' (Meera & Jayakumar 1995:455).

The variable age15 also has the opposite sign from that obtained when the pairwise correlation was considered. This negative sign is also inexplicable in terms of the interdisciplinary theory considered in this study but makes sense if crime in South Africa is being committed by older citizens, as implied by the variable aveage. This conclusion is contrary to that reached on page 96 when the preliminary analysis was conducted in Chapter Three. Yet the F-test performed on the age variable subset indicated, with a 99 percent level of confidence, that aveage and age15 do influence crime significantly ($\text{Prob} > F = 0.0008$). In the majority of other total crime research considered the variables

measuring the proportion of youth in the population were not negatively related to crime. However, in the property crime and violent crime research this was the case.

Fmedinc is also negatively related to crime, although this variable is an insignificant determinant. This sign is also opposite to that obtained in the preliminary analysis on page 93 in Chapter Three and cannot be explained in terms of the interdisciplinary framework used in this study. As this variable was not included in any other studies the result obtained cannot be compared to others. Wong (1995) emphasized the difficulty in selecting income variables which actually do measure the return from criminal activities and not the return from legitimate activities. Given the result obtained it must be concluded that female median income is not a good indicator of the return from illegitimate activities.

An index that is an amalgam of the many gender measures in this study was not constructed at the outset because it was not clear how this would be achieved in order to facilitate accurate interpretation. Therefore, it was necessary to conduct a F-test on the variable subset to gain an understanding of the influence of gender on crime. With a 99 percent confidence level ($\text{Prob} > F = 0.0000$), it was established that the gender variable subset does influence total crime in South Africa. As fmedinc is not a good measure of the likely returns from undertaking criminal activity, it is excluded for the purposes of interpretation. Faveinc and funnr appear to verify the emancipation hypothesis as they are related to crimes within businesses. The negative coefficient of faveeduc, however, indicates that the education of women deters crime which verifies the marginalisation hypothesis. Thus there is evidence of both influences on female criminality as all the variables considered are significant crime determinants. The results obtained by Box and Hale (1984), who considered female criminality exclusively, provided little support for the emancipation hypothesis and limited support for the marginalisation hypothesis.

Finally, it was necessary to perform F-tests on the law enforcement, economic and socio-economic variable subsets indicated in Table 3.2 on page 93 in Chapter Three. This was done to determine whether each of the variable categories was significant in

determining the total crime rate in South Africa in 1994. With a 99 percent confidence level it was possible to conclude that all of the variable categories significantly influenced the total crime rate, $\text{Prob}>F=0.0000$ for the law enforcement and economic variable subsets and $\text{Prob}>F=0.0004$ for the socio-economic variable subset. Howsen and Jarrel (1987) also found that in their study no one category of variables dominated in their ability to explain the crime rate. Meera and Jayakumar reached the same conclusion. Various law enforcement, economic and socio-economic variables considered are able to significantly explain crime in South Africa. This is generally consistent with 'the postulated hypotheses, as well as the outcome of similar studies undertaken' (Meera & Jayakumar 1995:459).

Below property crime in South Africa will be analyzed. Table 4.6 contains the results of all the studies that considered the property crime rate, including the present study.

Table 4.6: Regression Results for the Property Crime Rate

Variables	DeFronzo (1983)	Box and Hale (1984)	Howsen and Jarrel (1987)	Norström (1988)	Bennett (1991)
Probability of Prosecution, given Crime (probcort)			Average Clearance Rate Over 2 Years All Crimes <i>Negative, Significant</i>		
Average Length of Prison Sentence (avetime)			Average Sentence Over 2 Years Burglary <i>Negative</i> Robbery, Larceny <i>Positive</i>		
Poverty-gap Index (poor)	Percentage of Poor Families Burglary, Larceny <i>Positive, Significant</i> Motor Theft, Robbery <i>Positive</i>		Percentage of Poor Families All Crimes <i>Positive, Significant</i>	Real Wage Index <i>Negative, Significant</i> Percentage of New Employment Vacancies (Mostly Unskilled) <i>Negative</i>	
Gini Coefficient (gini)	Income Inequality Index Burglary, Larceny <i>Positive, Significant</i> Motor Theft, Robbery <i>Positive</i>				
Unemployment Rate (expanded definition) (unex)	Unemployment Rate Burglary, Larceny <i>Positive, Significant [2]</i> Motor Theft, Robbery <i>Positive</i>		Unemployment Rate Larceny <i>Positive</i> Burglary, Robbery <i>Positive, Significant</i>		
Average Number of Years of Education (aveeduc)					
Standard Deviation in Education Years (sdeduc)			Percentage of the Population with High School Education or Less Larceny <i>Negative</i> Burglary <i>Positive</i> Robbery <i>Positive, Significant</i>		Education Inequality Index <i>Negative, Significant</i>
Average Age (aveage)					
Proportion of Population between 16 and 25 Years (age16a25)	Percentage Male Population Aged 15 to 24 All Crimes <i>Negative</i>		Percentage of the Population Between the Ages of 15 and 24 All Crimes <i>Negative</i>		Proportion of Juveniles (0 - 14) <i>Negative, Significant</i>
Non-White/White Race Ratio (notwhpop)	Percentage of Population Which is Black Larceny, Motor Theft <i>Negative</i> Robbery <i>Positive, Significant [1]</i> Burglary <i>Negative, Significant [1]</i>		Percentage of Population Which is Black Larceny <i>Negative</i> Burglary <i>Positive</i> Robbery <i>Positive, Significant</i>		
Black and Coloured /Others Ratio of Average Income (bcaveinc)					

Table 4.6 continued

Variables	LaFree et al. (1992)	Meera and Jayakumar (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Probability of Prosecution, given Crime (probcort)	Incarceration Rate Burglary <i>Positive</i> Robbery <i>Positive, Significant [1]</i>	Prison Overcrowding Factor (Inversely Related) Housebreaking, Robbery, Total Theft <i>Positive, Significant</i> Motor Theft <i>Positive</i>	one	six	four	negative, significant
Average Length of Prison Sentence (avetime)			zero	zero	three	positive, significant
Poverty-gap index (poor)	Median Family Income Robbery <i>Positive, Significant</i> <i>Negative, Significant</i> Burglary <i>Positive</i> <i>Negative, Significant</i>		six	three	four	negative, significant
Gini Coefficient (gini)		Urban - Rural Income Disparity Housebreaking, Robbery, Total Theft <i>Negative</i> Motor Theft <i>Positive</i>	two	zero	six	negative, insignificant
Unemployment Rate (expanded definition) (unex)		Unemployment Rate Housebreaking, Robbery, Total Theft <i>Positive, Significant</i> Motor Theft <i>Positive</i>	nine	zero	six	negative, significant
Average Number of Years of Education (avoeduc)	Median Years of Education of Males 25 Years and Older Burglary <i>Positive, Significant</i> <i>Negative, Significant</i> Robbery <i>Negative</i> <i>Positive, Significant</i>		two	one	one	positive, significant
Standard Deviation in Education Years (sdeduc)			one	one	two	positive, significant
Average Age (aveage)			zero	zero	zero	positive, significant
Proportion of Population between 16 and 25 Years (age16a25)	Proportion of Male Population Aged 14 - 29 Robbery <i>Negative</i> Burglary <i>Positive</i>	Percentage of the Population Aged 15 - 29 All Crimes <i>Negative</i>	zero	one	nineteen	negative, significant
Non-White/White Race Ratio (notwhpop)			two	one	eight	positive, insignificant
Black and Coloured /Others Ratio of Average Income (bcaveinc)			zero	zero	zero	positive, significant

Table 4.6 continued

Variables	DeFronzo (1983)	Box and Hale (1984)	Howsen and Jarrel (1987)	Norström (1988)	Bennett (1991)
Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed)					
Black and Coloured/Others Ratio of Unemployment (expanded definition) (bcunex)					
Female/Male Gender Ratio (fempop)					
Female Average Income (faveinc)					
Female Average Education Years (faveeduc)		Female Undergraduates Plus Graduates Robbery, Burglary, Theft from Employers, Handling Stolen Goods <i>Negative</i> General Theft, Shoplifting, Fraud <i>Positive</i>			
Female/Male Ratio of Unemployment Rate (narrow definition) (funnr)		Female Labour Force Participation (inversely related) Burglary, Theft from Employers, Shoplifting <i>Positive</i> General Theft, Fraud, Handling Stolen Goods <i>Negative</i>			
Proportion of Mothers that Work (momwork)					
Median Income (medinc)	Median Family Income Robbery, Motor Theft <i>Positive</i> Burglary, Larceny <i>Positive, Significant [2]</i>		Median Household Income All Crimes <i>Positive, Significant</i>	Per Capita Expenditure on Durable Goods <i>Positive, Significant</i>	
Black and Coloured/Others Ratio of Median Income (bcmedinc)					
Female/Male Ratio of Median Income (fmmedinc)					
Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)			Percentage of Non-Agricultural Employment (Inversely Related) All Crimes <i>Positive</i>		Ratio of GDP by Manufacturing to that by Agriculture (Inversely Related) <i>Positive</i>

Table 4.6 continued

Variables	LaFree et al. (1992)	Meera and Jayakumar (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed)			zero	zero	zero	positive, significant
Black and Coloured/Others Ratio of Unemployment (expanded definition) (bcunex)			zero	zero	zero	positive, significant
Female/Male Gender Ratio (fempop)			zero	zero	zero	positive, significant
Female Average Income (faveinc)			zero	zero	zero	positive, significant
Female Average Education Years (faveeduc)			zero	zero	seven	negative, significant
Female/Male Ratio of Unemployment Rate (narrow definition) (funnr)			zero	zero	six	negative, significant
Proportion of Mothers that Work (momwork)			zero	zero	zero	positive, significant
Median income (medinc)			eight	zero	four	negative, insignificant
Black and Coloured/Others Ratio of Median Income (bcmedinc)			zero	zero	zero	positive, significant
Female/Male Ratio of Median Income (fmmedinc)			zero	zero	zero	negative, significant
Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)		Per Capita GNP (Inversely Related) Housebreaking, Total Theft Positive, Significant Motor Theft, Robbery Positive	zero	two	six	negative, significant

Table 4.6 continued

Variables	DeFronzo (1983)	Box and Hale (1984)	Howsen and Jarrel (1987)	Norström (1988)	Bennett (1991)
Proportion of Female Headed Households (femhh)			Percentage of Households with Low Family Ties All Crimes <i>Positive, Significant</i>		
Proportion of Population that Resides in Urban area (urban)	Population Size Robbery, Motor Theft <i>Positive, Significant [2]</i> Burglary <i>Positive</i> Larceny <i>Positive</i> <i>Negative</i>		Percentage of People in Cities All Crimes <i>Negative, Significant</i>		Proportion of People Living in Cities or Towns <i>Negative</i>
(urban) ²			Percentage of People in Cities Squared All Crimes <i>Positive, Significant</i>		Proportion of People Living in Cities or Towns Squared <i>Positive</i>
Additional Variables	Household Activity Index Robbery <i>Negative</i> Motor Theft <i>Positive</i> Burglary, Larceny <i>Positive, Significant [1]</i> Poverty Grant Robbery, Larceny <i>Positive</i> Motor Theft <i>Negative</i> Burglary <i>Negative, Significant [1]</i>	Birth Rate Robbery, Burglary, Handling of Stolen Goods <i>Negative, Significant</i> Theft from Employers, Fraud <i>Negative</i> Shoplifting, General Theft <i>Positive</i> Number of Single Women Robbery, Handling of Stolen Goods <i>Positive, Significant</i> Burglary, General Theft, Theft from Employers, Fraud <i>Positive</i> Shoplifting <i>Negative</i> Police Force's Gender Composition Fraud, Burglary <i>Positive, Significant</i> Shoplifting <i>Negative, Significant</i> General Theft, Theft from Employers, Robbery <i>Positive</i> Handling Stolen Goods <i>Negative</i> Conviction of Males Robbery, Burglary, Handling Stolen Goods, Fraud, Shoplifting <i>Positive, Significant</i> General Theft, Theft from Employers <i>Positive</i>	Police Density All Crimes <i>Negative, Significant</i> Tourism All Crimes <i>Positive, Significant</i> Poverty Grant All Crimes <i>Positive</i>		Per Capita Real GDP <i>Positive, Significant</i> Rate of Change in Per Capita Real GDP <i>Negative</i> (Every Variable was also Used in Polynomial Form - the Variable Squared)
Adjusted R ²	Robbery 0.562 Burglary 0.613, 0.680 Larceny 0.364, 0.462 Motor Theft 0.526, 0.548			Total Theft - not given	
R ²		Robbery 0.285 Burglary 0.604 General Theft 0.326 Shoplifting 0.713 Theft from Employers 0.07 Handling Stolen Goods 0.654 Fraud 0.729	Burglary 0.53 Robbery 0.77 Larceny 0.59		Total Theft 0.941

Table 4.6 continued

Variables	LaFree et al. (1992)	Meera and Jayakumar (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Proportion of Female Headed Households (femhh)	Percentage of Female Headed Households Robbery <i>Negative</i> , Significant [1] Burglary <i>Positive</i> , Significant [1] <i>Negative</i> , Significant		four	two	one	positive, significant
Proportion of Population that Resides in Urban area (urban)		Urbanisation Index Housebreaking, Total Theft <i>Positive</i> , Significant Motor Theft, Robbery <i>Positive</i> Population Size All Crimes <i>Negative</i>	six	three	eleven	negative, significant
(urban) ²			three	zero	one	positive, significant
Additional Variables	Household Activity Index All Crimes <i>Positive</i> , Significant [1] Consumer Price Index Burglary <i>Positive</i> , Significant[2] Robbery <i>Positive</i> , Significant [1]	Police Density Housebreaking, Robbery, Total Theft <i>Negative</i> Motor Theft <i>Positive</i> Police Development Expenditure All Crimes <i>Positive</i>				
Adjusted R ²	Robbery 0.25, 0.29 Burglary 0.19, 0.34	Housebreaking 0.96 Motor Theft 0.93 Total Theft 0.93 Robbery 0.95				
R ²	Robbery 0.43, 0.46 Burglary 0.38, 0.50					

In the property crime model some of the proxy variables used differed from those in the total crime model. Essentially age16a25 replaced age15, notwhpop replaced bcpop, bcunex replaced bcunnr and fmedinc was replaced by fmmedinc. The majority of the results obtained in the property crime research reviewed were similar to those obtained in the total crime research reviewed. In the above discussion regarding the total crime model most of the differences in the results were mentioned. One difference that was not mentioned and is important because it is contrary to the finding in this study, is that in the majority of the other property crime studies the variable poor was found to be positively related to crime. The signs on the estimation coefficients remained the same for all of the proxy variables in the property crime model, except gini, bcunex and medinc. For all of these variables the explanations given in the total crime analysis remain valid.

The variable median income is negatively related to the property crime rate, although it is an insignificant crime determinant. This result is not confirmed by the majority of the property crime research articles reviewed. And given this result, it must be concluded that median income is not a good proxy for the potential returns from undertaking criminal activities and that it is probably measuring the average return from pursuing legitimate activities. The F-test performed on the variables poor and medinc indicated that, with a 95 percent level of confidence, this subset does affect property crime significantly as $\text{Prob} > F = 0.0212$.

The income Gini coefficient acquired a negative sign in the property crime analysis, which is not explicable in terms of the interdisciplinary framework developed in Chapter Two but corresponds with the result obtained in the preliminary analysis on page 93 in Chapter Three. As noted in Chapter Three on page 94, in terms of the interdisciplinary approach it must be acknowledged that income inequality may be negatively related to crime as the dissimilar life experiences of potential criminals may hinder the formation of criminal associations. The result obtained in this study does not concur with the majority of results in other property crime studies, however, Meera and Jayakumar (1995:457) also obtained a negative and insignificant coefficient on the income inequality variable that they considered. They reported that this was an unexpected result but did

not provide any possible theoretical explanation for this. The F-test conducted on the entire income variable subset, including the variable gini, also indicated that with a 95 percent confidence level it can be concluded that the subset significantly determines property crime ($\text{Prob}>F=0.0218$).

There is a positive relationship between the Black and Coloured to Others ratio of the unemployment rate (expanded definition) and the property crime rate. This appears to verify the marginalisation hypothesis that certain race groups are discriminated against in the labour market. It is, however, not possible to compare this result as this variable was not tested in any of the other studies. A F-test was conducted on the race variable subset and, as was the case regarding the total crime model, the variables notwhpop, bcmedinc and bcaveinc were excluded as they are not dominant influences. With a 99 percent level of confidence, it can be concluded that the variables bcunex and bc7ed are dominant influences on the property crime rate ($\text{Prob}>F=0.0003$). Given the signs on these variables and considering that education may not be a deterrent at such a low level, it is difficult to determine which hypothesis predominantly explains the influence of race on crime. Bcunex appears to verify the marginalisation hypothesis but the effect of bc7ed is uncertain.

The F-tests performed on the education and age subsets, including the level and inequality variables, yielded the same results as were obtained for the total crime model. With a 99 percent confidence level, the variables in the subsets affect the crime rate significantly ($\text{Prob}>F=0.0000$ for the education variables and $\text{Prob}>F=0.0002$ for the age variables). $\text{Prob}>F=0.0000$ for the gender variable subset and the same conclusion is reached, which also corresponds with that obtained for the total crime model. Once again fmmedinc is excluded for the purposes of interpretation as it is not a good indicator of the returns from criminal activity. Faveinc and funnr still appear to verify the emancipation hypothesis and faveeduc the marginalisation hypothesis. Evidence of both influences on female criminality remain.

F-tests on the law enforcement, economic and socio-economic variable subsets were conducted. As for the total crime model, with a 99 percent confidence level it was

possible to conclude that all of the variable categories significantly influenced the crime rate in 1994, $\text{Prob}>F=0.0000$ for the law enforcement and economic variable subsets and $\text{Prob}>F=0.0001$ for the socio-economic variable subset. Again, the conclusions reached by Howsen and Jarrel (1987) and Meera and Jayakumar (1995) are confirmed in this study. Although it should be noted that compared to the total crime model the variables *aveage* and *fmmedinc* gained significance, at the 99 percent level of confidence. And that the variable *medinc* was no longer significant, even at a 90 percent confidence level.

Finally violent crime will be analyzed. Table 4.7 contains the results of all the research reviewed that considered the violent crime rate and also includes the results of the present study.

Table 4.7: Regression Results for the Violent Crime Rate

Variables	DeFrongo (1983)	Box and Hale (1984)	Howsen and Jarrel (1987)	Bennett (1991)
Probability of Prosecution, given Crime (probcort)			Average Clearance Rate Over 2 Years <i>Negative , Significant</i>	
Average Length of Prison Sentence (avetime)			Average Sentence Over 2 Years <i>Positive</i>	
Poverty-gap Index (poor)	Percentage of Poor Families All Crimes <i>Positive</i>		Percentage of Poor Families <i>Positive , Significant</i>	
Gini Coefficient (gini)	Income Inequality Index Murder, Aggravated Assault, Robbery <i>Positive</i> Rape <i>Negative</i>			
Unemployment Rate (expanded definition) (unex)	Unemployment Rate Murder, Aggravated Assault, Robbery <i>Positive</i> Rape <i>Positive , Significant [2]</i>		Unemployment Rate <i>Positive , Significant</i>	
Average Number of Years of Education (aveeduc)				
Standard Deviation in Education Years (sdeduc)			Percentage of the Population with High School Education or Less <i>Positive , Significant</i>	Education Inequality Index <i>Negative, Significant</i>
Average Age (aveage)				
Proportion of Population between 16 and 25 Years (age16a25)	Percentage of Male Population Aged 15 - 24 Murder, Robbery <i>Negative</i> Rape, Aggravated Assault <i>Positive</i>		Percentage of the Population Between the Ages of 15 and 24 <i>Negative</i>	Proportion of Juveniles (0 - 14) <i>Negative , Significant</i>
Non-White/White Race Ratio (notwhpop)	Percentage of Population which is Black Robbery, Aggravated Assault <i>Positive , Significant [1]</i> Murder <i>Positive , Significant [2]</i> Rape <i>Negative</i>		Percentage of Population which is Black <i>Positive , Significant</i>	
Black and Coloured /Others Ratio of Average Income (bcaveinc)				
Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed)				

Table 4.7 continued

Variables	LaFree et al. (1992)	Meera and Jayakumar (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Probability of Prosecution, given Crime (probpcrt)	Incarceration Rate Robbery <i>Positive, Significant</i> [1] Murder <i>Positive</i> <i>Negative</i>	Prison Overcrowding Factor (Inversely Related) Rape, Aggravated Assault <i>Negative, Significant</i> Violent Crimes <i>Positive, Significant</i> Murder, Robbery <i>Positive</i>	three	two	five	negative, significant
Average Length of Prison Sentence (avetime)			zero	zero	one	positive, insignificant
Poverty-gap Index (poor)	Median Family Income Robbery <i>Positive, Significant</i> <i>Negative, Significant</i> Murder <i>Positive, Significant</i> [1]		three	one	five	negative, insignificant
Gini Coefficient (gini)		Urban - Rural Income Disparity Rape, Aggravate Assault <i>Positive, Significant</i> Murder, Robbery, Violent Crimes <i>Negative</i>	two	zero	seven	negative, insignificant
Unemployment Rate (expanded definition) (unex)		Unemployment Rate Violent Crimes <i>Positive, Significant</i> Murder, Robbery <i>Positive</i> Rape, Aggravated Assault <i>Negative</i>	four	zero	ten	negative, insignificant
Average Number of Years of Education (aveeduc)	Median Years of Education of Males 25 Years and Older Robbery <i>Positive, Significant</i> <i>Negative</i> Murder <i>Negative, Significant</i> <i>Positive</i>		one	one	two	positive, insignificant
Standard Deviation in Education Years (sdeduc)			one	one	zero	positive, insignificant
Average Age (aveage)			zero	zero	zero	positive, insignificant
Proportion of Population between 16 and 25 Years (age16a25)	Proportion of Male Population Aged 14 - 29 Robbery <i>Negative</i> Murder <i>Positive</i>	Percentage of the Population 15 - 29 Years Murder, Robbery, Violent Crimes <i>Negative</i> Rape, Aggravated Assault <i>Positive</i>	zero	one	eighteen	negative, insignificant
Non-White/White Race Ratio (notwhpop)			five	zero	four	positive, insignificant
Black and Coloured /Others Ratio of Average Income (bcaveinc)			zero	zero	zero	positive, insignificant
Black and Coloured/Others Ratio of Proportion with Primary Education (bc7ed)			zero	zero	zero	positive, insignificant

Table 4.7 continued

Variables	DeFronzo (1983)	Box and Hale (1984)	Howsen and Jarrel (1987)	Bennett (1991)
Black and Coloured/Others Ratio of Unemployment (narrow definition) (bcunnr)				
Female/Male Gender Ratio (fempop)				
Female Average Income (faveinc)				
Female Average Education Years (faveeduc)		Female Undergraduates Plus Graduates All Crimes Negative		
Female/Male Ratio of Unemployment Rate (narrow definition) (funnr)		Female Labour Force Participation (inversely related) Aggravated Assault Positive		
Proportion of Mothers that Work (momwork)				
Median Income (medinc)	Median Family Income All Crimes Positive		Median Household Income Positive, Significant	
Black and Coloured/Others Ratio of Median Income (bcmedinc)				
Female/Male Ratio of Median Income (fmedinc)				
Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)			Percentage of Non-Agricultural Employment (Inversely Related) Positive	Ratio of GDP by Manufacturing to that by Agriculture (Inversely Related) Positive, Significant
Proportion of Female Headed Households (femhh)			Percentage of Households with Low Family Ties Positive, Significant	
Proportion of Population that Resides in Urban area (urban)	Population Size Rape, Robbery Positive, Significant [2] Murder Positive, Significant [1] Aggravated Assault Positive		Percentage of People Living in Cities Negative, Significant	Percentage of People Living in Cities or Towns Positive
(urban) ²			Percentage of People Living in Cities Squared Positive, Significant	Percentage of People Living in Cities or Towns Squared Negative, Significant
Additional Variables	Household Activity Index Murder, Robbery Negative Rape, Aggravated Assault Positive Poverty Grant Murder, Rape Negative, Significant [2] Aggravated Assault Negative Robbery Positive	Birth Rate All Crimes Negative, Significant Number of Single Women All Crimes Positive, Significant Police Force's Gender Composition Aggravated Assault Positive, Significant Robbery Positive Conviction of Males All Crimes Positive, Significant	Police Density Negative, Significant Tourism Positive, Significant Poverty Grant Positive	Per Capita Real GDP Negative Rate of Change in Per Capita Real GDP Negative (Every Variable was also Used in Polynomial Form - the Variable Squared)
Adjusted R ²	Robbery 0.562 Murder 0.749 Aggravated Assault 0.575, 0.577 Rape 0.476, 0.483			
R ²		Robbery 0.285 Aggravated Assault 0.877	Robbery 0.77	Murder 0.71

Table 4.7 continued

Variables	LaFree et al. (1992)	Meera and Jayakumar (1995)	Positive / Significant	Negative / Significant	Insignificant	Brown (2001)
Black and Coloured/Others Ratio of Unemployment (narrow definition) (bcunnr)			zero	zero	zero	negative, insignificant
Female/Male Gender Ratio (fempop)			zero	zero	zero	positive, insignificant
Female Average Income (faveinc)			zero	zero	zero	positive, insignificant
Female Average Education Years (faveeduc)			zero	zero	two	negative, insignificant
Female/Male Ratio of Unemployment Rate (narrow definition) (funnr)			zero	zero	one	negative, insignificant
Proportion of Mothers that Work (momwork)			zero	zero	zero	positive, insignificant
Median Income (medinc)			one	zero	eight	positive, insignificant
Black and Coloured/Others Ratio of Median Income (bcmmedinc)			zero	zero	zero	positive, insignificant
Female/Male Ratio of Median Income (fmmedinc)			zero	zero	zero	negative, insignificant
Ratio of Workers in Manufacturing to Service Industry Workers (manuserv)		Per Capita GNP (Inversely Related) Violent Crimes Negative, Significant Murder, Rape, Aggravated Assault Negative Robbery Positive	one	one	five	negative, insignificant
Proportion of Female Headed Households (femhh)	Percentage of Female Headed Households Robbery Negative, Significant [1] Murder Negative		one	one	three	positive, insignificant
Proportion of Population that Resides in Urban area (urban)		Urbanisation Index Rape, Aggravated Assault Negative, Significant Violent Crimes Positive, Significant Robbery, Murder Positive Population Size Murder, Robbery, Violent Crimes Negative Rape, Aggravated Assault Positive	six	three	eleven	negative, insignificant
(urban) ²			one	one	zero	positive, insignificant
Additional Variables	Household Activity Index Robbery Positive, Significant [1] Murder Positive Negative Consumer Price Index Robbery Positive, Significant [1] Murder Positive	Police Density Rape, Aggravated Assault Positive Murder, Robbery, Violent Crimes Negative Police Development Expenditure Rape, Aggravated Assault Negative Murder, Robbery, Violent Crimes Positive				
Adjusted R ²	Robbery 0.25, 0.29 Murder 0.00, 0.02	Murder -0.08 Robbery 0.95 Rape 0.91 Aggravated Assault 0.86 Violent Crimes 0.94				
R ²	Robbery 0.43, 0.46 Murder 0.23, 0.25					

As mentioned in the previous section when the violent crime model was estimated, the results of this model are not very reliable. Therefore, they must be interpreted with caution as not much significance can be attached to the conclusions reached. The F-tests conducted on all the variable subsets all revealed that the joint null hypotheses that the subset variables collectively make no contribution towards explaining the violent crime rate could not be rejected. Prob>F=0.7657 for the subset containing the variables poor and medinc, Prob>F=0.9062 for the entire income variable subset, Prob>F=0.4255 for the education subset, Prob>F=0.6946 for the age subset, Prob>F=0.4499 for the race subset and Prob>F=0.6207 for the gender subset. Accordingly, none of these variable subsets were dominant influences on the violent crime rate in South Africa in 1994. On page 126 in the previous section it was noted that only the variable probcort significantly determined the violent crime rate and only with a confidence level of 90 percent. Nonetheless, the violent crime model will be analyzed in this section even though the analysis can only be considered as exploratory in nature. The violent crime model will be compared to the total crime model, as the property crime model was, because total crime is the broadest category of crime and is therefore the best standard frame of reference.

In the violent crime model different proxy variables were used in some instances. Age16a25 was used instead of age15, notwhpop instead of bcpop and fmmedinc instead of fmedinc. The majority of the results obtained in the violent crime studies considered were similar to those obtained in the total crime studies considered. In the above discussion regarding the total crime model most of the differences in the results were mentioned. Differences that were not mentioned and which are important because they are contrary to the findings in this study, are that in the majority of the other violent crime research the variables probcort and poor were positively related to crime. The signs on the estimation coefficients were the same for all of the proxy variables in the violent crime model, except the variable gini. For all of the variables the explanations given in the total crime analysis therefore remain the same.

As in the property crime model the Gini coefficient has a negative sign, for which a possible explanation was provided in Chapter Three on page 94. It was contended that

income inequality may be negatively related to the crime rate as the different income statuses of potential criminals in society preclude the establishment of criminal associations. The result obtained in this study does not correspond with the majority of the results in other violent crime studies, however, as noted Meera and Jayakumar (1995:457) also obtained this result.

F-tests on the law enforcement, economic and socio-economic variable subsets were performed for the violent crime model. In all cases the joint null hypotheses that the subset variables collectively make no contribution towards explaining violent crime could not be rejected. None of the broad variable categories significantly explained the violent crime rate in South Africa, $\text{Prob}>F=0.1584$ for the law enforcement variable subset, $\text{Prob}>F=0.9672$ for the economic variable subset and $\text{Prob}>F=0.8246$ for the socio-economic variable subset. The conclusions reached by Howsen and Jarrel (1987) and Meera and Jayakumar (1995) that all categories of explanatory variables are significant crime determinants are therefore not confirmed in this study for the violent crime model.

4.6 CRIME PREVENTION POLICY RECOMMENDATIONS

All the models of crime were considered in detail in order to gain a better understanding of the causes of South African crime. As mentioned on pages 118 and 119 in Section 4.3, the elasticities of the crime rate with respect to explanatory variables must be calculated for each of the crime models. These elasticity estimates are necessary in order to inform appropriate crime prevention policy as they provide information regarding the relative importance of variables in determining the crime rate.

Constant-elasticities were calculated relating to explanatory variables in each of the models by applying the formula: $\text{elasticity} = (\text{estimation coefficient})(\text{mean } X/\text{mean } Y)$. The estimation coefficients were obtained from Table 4.4 on page 124 and the mean values used can be found in Table D.1 in Appendix D on page 264. However, many of the explanatory variables in the crime models had to be excluded. In some instances it is not clear that practical crime prevention policies can be implemented based on the elasticity estimates. In other instances the variables are not good proxies for what they intend to measure or they have the wrong signs on their coefficients owing to the use

of reduced-form models, which only demonstrate their net effect on crime. After the process of elimination, the variables in Table 4.8 below remained and represent those for which it was feasible to calculate elasticity estimates.

Table 4.8: Elasticity Estimates for the Crime Models

	Total Crime	Property Crime	Violent Crime
Law Enforcement Variables			
probcort	(3) -0.2894854	(3) -0.3825369	(1) -0.4353642
Economic Variables			
poor	(5) -0.0477376	(5) -0.049308	(-0.0596126)
gini	(0.0421982)		
sdeduc	(2) 0.4265482	(2) 0.5193467	(0.5810469)
bcunex		(6) 0.0155033	
faveeduc	(1) -0.6391971	(1) -0.7961682	(-0.9115876)
Socio-Economic Variables			
femhh	(4) 0.1397274	(4) 0.1896189	-0.2239239

* Insignificant crime rate determinants are indicated in parenthesis. The other determinants are numbered in order of importance.

The elasticity estimates calculated in the other research reviewed for the purposes of this study were not included for comparison. Chiricos and Delone (1992:426) clearly pointed out that when regression analysis is used the estimation coefficients, which are used to determine elasticity estimates, are only comparable across studies if in each study exactly the same instruments were used to measure the independent and dependent variables. According to Meera and Jayakumar (1995:456), who considered crime in a developing country, the causes of crime are not the same in all countries and the degree of their influence differs. Therefore elasticity estimates are not expected to correspond across nations and studies. While it was reasonable to compare the signs and levels of significance attached to estimation coefficients in other studies, it is not reasonable to assume that the numerical values of the estimation coefficients and the mean values of the independent and dependent variables are comparable.

From the information given in the table above it is clear that overall proportional changes in the economic variables have the biggest impact on total and property crime. Therefore the economic variables are the most important variable category influencing the total and property crime rates. They are followed in importance by the law enforcement variable category and then the socio-economic variable category. In the case of violent crime only the law enforcement variable category is significant. However, the elasticity of the crime rate with respect to the probability of prosecution is larger in this case than for the other categories of crime. Except for total crime, the above results regarding the probability of prosecution correspond with Cornwell and Trumbull's findings (1994:361) after reviewing existing research; namely, that the elasticity estimate is normally between 0.3 and 1.1 percent. Cognisance is, however, taken of their conclusion that these estimates are higher than they should be and the other elasticity estimates are lower than they should be because unobserved heterogeneity was not controlled for in this study as panel data was not available.

As noted in Chapter One on page 34 traditionally crime prevention has been dealt with entirely via the criminal justice system. However, worldwide crime has increased despite increased expenditure on the criminal justice system. From the above elasticity estimates it is evident that the law enforcement variable the probability of prosecution is a very important aspect of crime prevention in South Africa. However, it is also evident that other public expenditure categories can be used to deter crime, changes in the education variables specifically appear to have a bigger influence on the crime rate. In Chapter One on page 37 it was stated that the main aim of this study is to determine the type of public expenditure required for effective crime prevention. It must be concluded that in South Africa the exclusive use law enforcement is not appropriate, except perhaps in the case of violent crimes. This verifies the central hypothesis in this study; namely, that more public expenditure exclusively on the criminal justice system is not most effective and that crime prevention policy can be made more effective by also employing the types of public expenditure that bring about changes in the economic and socio-economic variables which have a greater impact on crime.

In Chapter Two on pages 62 and 63 it was noted that traditionally Neoclassical economists have argued that expenditure on the criminal justice system is more efficient in crime prevention than other types of public expenditure as it impacts solely on the crime rate. Other types of public expenditure have an impact on all individuals in society, whether or not they possess a criminal disposition. However, Wong (1995:237) emphasized that a distinction between 'prosperity-induced' and 'poverty-induced' crime must be made. In terms of the economic theory of crime 'prosperity-induced' crime is related to the returns from illegitimate activity, whereas 'poverty-induced' crime is related to the deprivation associated with pursuing legitimate activities. In Chapter Two on pages 64 to 76 an interdisciplinary theory of crime was developed in order to broaden the economic theory and increase its ability to explain crime causation. As a result it is possible to evaluate policies aimed at increasing the returns from legitimate activities as well as law enforcement policy, which decreases the returns to illegitimate activity. Essentially policies directed at increasing the returns from legitimate activities focus on alleviating social problems, using government agencies other than the criminal justice system to assist in crime prevention.

Although specific policy alternatives will not be assessed, general policy areas which should be considered for crime prevention will be commented on. As specific policies are not being evaluated no cost information is included in this analysis, the focus is on the relative effectiveness of various government policies in crime prevention. For violent crime in South Africa no conclusive recommendations can be made as the model is unreliable but it appears as if raising the probability of prosecution via the criminal justice system prevents this type of crime. For the other categories of crime, law enforcement and policies aimed at reducing 'poverty-induced' crime are recommended.

For total and property crime in South Africa policies that reduce the inequality in education, particularly those that raise the education level of women, seem most appropriate for preventing crime. Traditional crime prevention policies which raise the probability of prosecution also have a significant impact on these categories of crime and must be maintained. In the long-term when other policy measures have had a significant impact on reducing crime it may be possible to reduce criminal justice system

expenditure. Policies aimed at improving the well-being in female headed households must also be targeted. The South Africa Foundation also emphasized the importance of this '[o]nly through a **rebuilding of these social structures** can changes in attitudes and culture be brought about, which lead to renewed respect for the law and for the judicial process' (1996:37). However, policies focussing on general poverty relief are also important in preventing crime and must not be neglected.

Most of the unemployment measures could not be used as they have signs that do not enable practical policy intervention, however, it appears that policies aimed at reducing unemployment among the Black and Coloured population would deter property crime to some extent. The potential of employment creation policies to reduce crime in South Africa merits further research. In their study of a developing country Meera and Jayakumar concluded that 'policies should include the setting up of socio-economic institutions to combat unemployment' (1995:460). According to the South Africa Foundation, 'unemployed people, often desperate and with slim prospects for future employment, continue to grow in number' (1996:29) and therefore 'if crime is to be tackled in the long run, **appropriate growth, labour market and educational policies** providing jobs to millions of people need to be adopted ... In addition, rapid job-creation would help to justify state efforts to tackle crime effectively' (1996:37).

4.7 CONCLUSION

At the beginning of this chapter Cornwell and Trumbull's survey (1989) of the empirical research undertaken by the deterrence writers was considered. An international literature survey was also conducted for the purposes of this study, which considered the contributions of some authors who have adopted an interdisciplinary approach to crime research. Important empirical modelling issues were raised in these surveys and it was concluded that the majority of these can be suitably addressed in the present study. Thus the data used and the specification of the crime models are in line with that employed in the studies considered.

To summarise, in order to understand the relative importance of the various factors in determining crime in South Africa so that appropriate prevention policy

recommendations can be made, in each of the crime models specified a hybrid reduced-form equation was used. This equation contained elements of both the demand for and supply of offences. The other studies reviewed also adopted this approach. The simultaneous demand-and-supply equation system originally considered was not used as the objective of this study is not to determine the optimal quantity of offences, return from criminal activities or probability of punishment. However, simultaneity was not avoided because the probability of prosecution is likely to be an endogenous variable in the reduced-form crime rate equations. The two stage least squares procedure was therefore considered, to estimate the coefficients of the parameters of the equation systems. Owing to availability, a cross-sectional data set was used and therefore it was not possible to account for unobserved heterogeneity. Log-linear transformations were considered in order to generate direct elasticity estimates. However, when the variables were logged missing values were generated for some of them and thus a linear model specification was adopted. Therefore, after the models were estimated, elasticity estimates of the crime rate with respect to explanatory variables were calculated from the coefficients obtained.

Before the three crime models could be estimated it was necessary to make some changes to the data and the models to improve the results of the analyses. The dependent crime rate variables were normalised using Box-Cox transformations. In cases where independent variables had missing values these were imputed as it was important to retain these variables in the analyses for substantive reasons. The recalculations that had to be made all concerned the way in which the statistical package used dealt with the mathematical problems relating to the number zero.

The first step in the estimation procedure of each of the crime models was to ascertain the determinants of the endogenous variable the probability of prosecution. All the determinants identified, which were revealed by performing a stepwise regression using a process of backward elimination, were explicable in terms of Howsen and Jarrel's reasoning (1987) and therefore appeared to be valid. Next Hausman specification tests were applied to each of the models and it was established that the probability of prosecution is an endogenous variable and that, therefore, given the simultaneity in the

equation systems, two stage least squares estimation procedures are appropriate. The models were then estimated using this procedure and diagnostic analyses were performed on them. The Cook-Weisberg test indicated that heteroscedasticity was present in the violent crime model, therefore the White method was applied to correct this. It was then established that this model is not robust and that any conclusions drawn from these results can only be considered as exploratory in nature.

Compared to the other studies reviewed, it was noted that the present study includes more explanatory variables. Where possible, for each variable category inequality and level measures were included. Many economic variables relating to race and gender were also included and none of these were considered in the other studies. F-tests on the variable subsets relating to each variable category in all of the models, excluding the violent crime model, established that with at least a 95 percent confidence level the variable subsets all contributed to explaining the crime rate. Therefore the inclusion of the additional variables in this study was not superfluous.

The estimation results obtained in this study for each of the crime models were compared to the results obtained in other studies and to the predicted outcomes of the interdisciplinary model of crime developed in Chapter Two. In many instances the results of this study did not correspond with the findings in the majority of other studies reviewed. However, in most cases they did correspond with the findings of at least one other researcher. In most instances the results of this study were explicable in terms of the interdisciplinary theory. Alternative theories were provided to explain the negative signs on the variables urban, age15 and age16a25 and the positive sign on the variable aveage. The negative sign on the variable gini in the case of property and violent crimes was also explained. The variables avetime, aveeduc, bc7ed, fempop, fmedinc and fmmedinc were found to be bad proxies for what they intended to measure. This was also the case for the property crime variable medinc.

It is internationally recognised that it is the government's duty to implement effective crime prevention policy. However, it was concluded that the exclusive focus on criminal justice system reform in South Africa is inappropriate. F-tests conducted on the broad

law enforcement, economic and socio-economic variable subsets indicated that, with the exception of violent crimes, with a 99 percent confidence level all categories influence the crime rate significantly. For total and property crimes the elasticity estimates indicated that many other public policies can be used to deter crime, in fact, changes in certain education outcomes appear to have a greater impact on crime than proportional increases in the probability of prosecution. Other policies may also have a greater impact on crime than general deterrence, considering that according to Cornwell and Trumbull (1994) failure to control for unobserved heterogeneity lowers other estimation coefficients relative to the deterrence coefficients. Although specific policy options were not evaluated, generally it can be stated that policies targeting female headed households and poverty also have an important impact on crime. The elasticities related to most of the unemployment variables were not estimated as they have the wrong signs but policies which reduce unemployment among the Black and Coloured population appear to deter property crime to some extent.

Considering the other types of public expenditure, besides criminal justice system expenditure, that are able to significantly influence the crime rate, it is evident that much of South African crime is 'poverty-induced' and not 'prosperity-induced'. This verifies the central hypothesis in this study, for effective crime prevention more expenditure exclusively on the criminal justice system in South Africa is not the solution and in order to increase policy effectiveness, other types of public expenditure must also be used which have a significant impact on crime because they relate directly to the economic and socio-economic variables which cause crime. It is important to note that these other types of public expenditure, which normally form part of general development policy, have positive external effects in terms of crime prevention. For effective crime prevention policy it is therefore necessary to abandon the traditional emphasis on decreasing the returns related to illegitimate activities, in favour of an interdisciplinary theory which allows for a shift in emphasis towards increasing the returns related to legitimate activities. Essentially the activities of all government agencies must be considered regarding their ability and effectiveness in crime prevention if the government is to address the crime problem effectively.

NOTES:

1. Using the two stage least squares procedure with panel data, they included two identification instruments that are exogenous in order to determine whether or not the crime rate influences the probability of arrest and the size of the police force. The instruments are the proportion of crimes involving "face-to-face" contact and the per capita tax revenue respectively. Using a F-test they concluded that these two variables do not add to the predictive power of the model. A Wu-Hausman test of the contrast between the two sets of panel data estimates indicated that the presence of conventional endogeneity could be rejected. Therefore on efficiency grounds the ordinary least squares procedure was favoured.
2. In their summary of existing research, they only reported on the coefficients of the law enforcement variables, excluding the economic and socio-economic variables that other researchers considered. Even in their own research, they did not explore the implications of their findings regarding the economic and socio-economic variables that they included.
3. The rationale for considering only aggregate level data was discussed in Chapter Two on pages 57 and 58, and that regarding the focus on property and violent crimes in Chapter One on pages 42 to 45.
4. Although from the table it does not appear as if the study by Box and Hale includes law enforcement variables, those included have been checked off as gender variables because they relate specifically to females.
5. It should be noted that the hypothesised signs have been attributed to the coefficients of the variables and in cases where a variable may assume any sign, a positive sign was allocated.

6. According to Gujarati (1995:673), the order condition is a necessary but not sufficient condition for identification, whereas the rank condition is both a necessary and sufficient condition. 'In practice, though, the order condition is generally adequate to ensure identifiability'.
7. The presence of gang activity variable is excluded following the discussion in Chapter Three on page 95.
8. The variable bcmedinc alone had 45 missing observations.
9. Fifteen missing values were generated for the variable bcpop.
10. In the statistical package which was used zero divided by any number was calculated as a missing value, this was corrected and zeros were imputed. The median of zero was taken to be zero and imputed accordingly. If the denominator in a calculation was zero this was altered to be 0.0000001, so that a number of infinity would not be generated but a very large number instead. Finally when the variables, used to compare one portion of the population to another in the form of a ratio, both hold values of zero a value of one was imputed to indicate their one-to-one relationship.
11. The logged fmedinc variable alone has 75 missing values. In many cases a missing value was generated because the unlogged variable has a value of zero.
12. It should be remembered that: $\text{elasticity} = (\text{slope})(\text{mean X}/\text{mean Y})$.
13. This method was employed as it yielded better results than those obtained when the variables that are significantly correlated with the probability of prosecution in terms of the Pearson pairwise correlation statistics were considered. Fewer variables are significant at the 0.05 level and some are included that had not been identified in terms of pairwise correlation.

14. In the property crime model $\text{propcr} = - 1.236745 - 3.26417 \text{ urban} + 2.207829 \text{ urban}^2$ and in the violent crime model $\text{violcr} = - 2.843022 - 3.303268 \text{ urban} + 2.203372 \text{ urban}^2$.
15. For the property crime model the Pearson pairwise correlation results can be found in Table C.1 in Appendix C on page 258 and for the violent crime model in Table C.2 on page 261.

CHAPTER FIVE

PRODUCTION FUNCTION ANALYSIS REGARDING THE CRIMINAL JUSTICE SYSTEM

5.1 INTRODUCTION

In Chapter Two of the dissertation an interdisciplinary theory of crime causation was developed within the framework of the economic model of the market for offences. This model captures the behaviour of criminals, law enforcement agencies and private individuals. Essentially the number of offences is seen as a function of economic, socio-economic and law enforcement variables. The breadth of this model enables an assessment of the relative importance of law enforcement variables in determining crime and this was formally modeled within the South African context in Chapter Four using multivariate techniques. Chapter Four showed that law enforcement variables are not the only or even the dominant influence on the number of offences, however, they definitely have an important role to play. Given this finding and the fact that these variables offer the most direct policy instruments for preventing crime, this chapter focuses detailed attention on the performance of the criminal justice system and therefore the model used only captures the behaviour of law enforcement agencies.

As noted in Chapter One, the approach is to model departments of the criminal justice system in terms of a production function. Such a model should be able to capture the complex interrelationships among resource inputs and outputs (principal services delivered) in the criminal justice system. In order to ultimately determine the relationship between each of the resource inputs in the departments of Safety and Security and Justice and the crime rate - the relationship between the output of each department and the crime rate must be considered as an intermediary function. In this way the impact of any significant change in resource allocation within the departments can be quantified within the framework of the model.

In this chapter firstly, crime-related production function research is considered in order to establish internationally recognized model specifications for such empirical work. Then, data

availability in South Africa is assessed and the model to be used in this study is specified. Next, the model is estimated for the different crime categories; total crime, property crime and violent crime. The results are then interpreted and compared with those of other studies. Finally, by also considering the crime rate equations estimated in Chapter Four, policy recommendations are made for effective resource allocation in the prevention of each category of crime.

5.2 REVIEW OF EXISTING RESEARCH

In this study production function analyses will be undertaken. These will provide information on the resource inputs in the criminal justice system which are effective in preventing crime. Essentially crime-related production function analyses constitute a productivity study of departments in the criminal justice system. According to Cloninger (1994:276) this type of analysis is necessary because '[s]tudies finding a negative correlation of the crime rate with the arrest rate often claim to uphold this claim [that increased resources devoted to police will deter criminal activity]. This is unjustified unless there is a strong link between the amount of police input and the arrest rate'. The empirical analysis undertaken in Chapter Four indicated that law enforcement variables are significant determinants of the South African crime rate, in this chapter the relationship between law enforcement variables (outputs) and resource inputs in the criminal justice system must be considered.

In the international literature production function theory is well developed. But although 'many econometric studies of crime ... have been published ... [only a] small fraction of these have estimated a ... production function' (Cameron 1991:313). Van Tulder (1999:476) emphasises this point - '[p]roductivity studies can be found in the literature, particularly for the police departments and to a lesser extent for the judicial authorities and the prison system'. Empirical literature regarding the costing of inputs is also available. Regarding the South African literature specifically, no other author has undertaken empirical research at a national level which has focussed on identifying the resource inputs that are important in influencing the output of the criminal justice system, let alone considered the effectiveness of using various inputs in crime prevention.

For the purposes of this research a sample of international studies concerning crime-related production functions was reviewed. These studies were conducted to achieve many different aims. Some are focussed on improving input measures (Burrows & Tarling 1982), others on output measures (Burrows & Tarling 1982, Chapman et al. 1975), or the specification of the production function (Cameron 1991); while yet others are concerned with the crime-reduction effects of changes in inputs - that is, with the ultimate outcome (Pogue 1975, van Tulder 1999). In all cases only aggregate level studies concerning total crime and property or violent crimes were considered. Also in all cases considered, production functions are estimated for a single department in the criminal justice system, that is the assumption was made that economies of scope in the system are not important. Detailed information regarding these studies is presented in Table 5.1 below.

Table 5.1: Important Features of Police Production Function Studies

	Chapman et al. (1975)	Pogue (1975)	Burrows and Tarling (1982)	Cameron (1991)	van Tulder (1999)
Geographical Area	Los Angeles	United States SMSAs	England and Wales policing units	American States	Netherlands
Data Type	time-series	cross-section	cross-section	cross-section	time-series
Estimation Procedure	OLS	2SLS	2SLS	OLS and 2SLS	OLS
Functional Form	log-linear	log-linear	log-linear	quadratic log-linear power semi-log	log-linear
Crime Type (reported crime)	property	total crime murder rape robbery assault burglary larceny motor theft	total crime	against persons property	violence petty thefts aggravated thefts drunk driving drug crimes other crimes
Variables:					
Output	✓	✓	✓	✓	✓
Input cost		✓			✓
Labour input	✓		✓	✓	
Capital Input					✓
Workload		✓	✓	✓	✓
Additional Variables	newly released prisoners, structural change dummy variable				scale effects trend variable, police reorganization dummy variable
Population size		population density, population		population density, population	

OLS - Ordinary Least Squares

2SLS - Two Stage Least Squares

SMSA - Standard Metropolitan Statistical Area

* It should be noted that Cameron's study, which was specifically designed to improve the specification of production functions, used Pogue's research as a basis for comparison.

* Van Tulder (1999) also did a production function analysis of the public prosecutions department and the judicial system using exactly the same model specification applied to the police department production function, however, no dummy variable was included for reorganization within this component of the criminal justice system.

Table 5.1 indicates many alternative methods used to conduct empirical production function analyses of departments in the criminal justice system. The units of analysis used in studies vary considerably in size, from policing units to a country, and this does not appear to be related to the type of data used. In these studies cross-section and time-series data have been used, depending on availability. Phillips (1978), Darrough and Heineke (1978) and Gyapong and Gyimah-Brempong (1988), who all estimated cost functions which present the dual problem to production functions, used pooled data in their analyses. In some of the studies crime (the proxy for workload), and even resource input, were considered to be a function of the output and because of simultaneity a two stage least squares estimation procedure was adopted. In other studies these variables were considered to be exogenous, resulting in the use of the ordinary least squares procedure. Log-linearity is generally assumed, in Cameron's study (1991), however, the constraint of monotonicity was relaxed by adding squared input terms. Log-linear transformations are generally applied to determine the elasticity of the output with respect to input.

In each of the studies different variables were actually used as proxies for the variables named in Table 5.1. These proxy variables will all be considered in the next section when South African data availability for analyzing the productivity of criminal justice departments is assessed. The variables used in the various studies will only be referred to specifically when the results of these studies are compared to the South African results. However, some general comments regarding the categories of variables which are included in production function studies will be made.

"[P]roducers" in the law enforcement system often produce a whole range of products' and therefore empirical analysis is complicated when output must be integrated into one criterion (van Tulder 1999:477). One of two approaches is normally adopted to determine output - either it is assumed that a separate production function can be formulated for each of the outputs, or an index of joint output is calculated, which still maintains the assumption of nonjoint outputs. Of the studies reviewed, only Chapman et al. adopted the latter approach. In this study the former approach is adopted as information is only available regarding one operational statistic that can be used as a proxy for departmental output

concerning the criminal justice system in South Africa. That is, the probability of prosecution in the case of the South African Police Service and the probability of conviction concerning the Department of Justice. Separate analyses will, however, be conducted regarding total crime, property crime and violent crime.

Resource inputs are generally approximated in two ways, either as the number of inputs employed or the expenditure on inputs. In three of the studies considered the number of personnel was included and in the other two expenditure on personnel, added to expenditure on other resources, was used as an indicator of input. It should be noted that Burrows and Tarling purposefully excluded the personnel expenditure variable that they had initially considered because 'this measure represents a poor index of additional police effort' (1982:10). Capital input was only included as a separate variable in van Tulder's study (1999), in the form of a technology indicator. Gyapong and Gyimah-Brempong (1988:864) stress that by assuming fixed capital-labour ratios it is not possible to measure the substitution possibilities between capital and labour. Workload variables are 'included as an ad hoc device to cope with the fact that ... [log-linear] functions do not allow for variations in returns to scale' (Cameron 1991:316). Population size variables 'are controls for variations in the difficulty of catching criminals across regions' (Cameron 1991:317). These scale variables are included in studies for this reason. In this study all the above-mentioned categories of independent variables are included in the production function analyses. The number of personnel is used as the proxy for labour input; whereas expenditure on inputs are used as proxies for capital inputs, owing to data availability.

5.3 DATA AUDIT

Provided that the production function models are based on accurate data which provides sufficiently good proxies of the relevant variables in departments of the South African criminal justice system, they can be used as a guide in policy making. If the data analyzed are not very reliable or appropriate then a situation of 'garbage in - garbage out' will result. In this study this problem is overcome to a large extent as the data considered in this chapter is comprised of the operational statistics of the departments of the criminal justice system - the South African Police Service, Department of Justice and Department of

Correctional Services. It should be noted that this operational information obtained directly from the departments is different in nature to the criminal justice system data used in Chapters Three and Four, which emanates from departmental publications and Human Science Research Council data bases. Essentially, in terms of the former pooled data analyses over the medium term are possible, whereas the later allowed for short term cross-sectional analyses.

The empirical analysis of production functions was limited in some ways. Mostly, in terms of the time period, geographical areas and operational information that could be considered. In the third quarter of 1996 the South African Police Service made some changes to the method of collecting crime statistics and as the definitions of specific crimes are not completely compatible with those used prior to this, the time period considered for production function modeling is limited to quarters beyond the middle of 1996. Geographically the unit of analysis to be used in the modeling is constrained to provinces, the lowest level at which resource input information is available.

The Department of Correctional Services does not record information regarding the number of prisoners that have been previously incarcerated. Although there is not general consensus on what constitutes prison output, it could possibly be argued that prisons should produce specific deterrence of known criminals. Increased prison output would be indicated by a reduction in the recidivism rate of prisoners. However, as this information does not exist and no proxy variables are available, it is not possible to measure prison output and therefore a prison production function cannot be empirically assessed. This poses a severe constraint on South African studies as ultimately the effectiveness of the Department of Correctional Services cannot be ascertained. It should, however, be noted that van Tulder (1999), who conducted an extensive study for the purpose of determining the crime reduction effects of the activities of law enforcement agencies, excluded the prison system in his study.

The Department of Justice was only able to provide information at national level and therefore it is also not possible to empirically analyze a production function for this

department, as the number of observations is too small.¹ Ultimately this poses a severe limitation on studies concerning the productivity of the South African criminal justice system. It is not possible to assess the effectiveness of either the Department of Justice, or the Department of Correctional Services and this, in turn, makes it impossible to consider the criminal justice system in an integrated way. Although it was initially thought feasible, it is not even possible to ascertain the relative importance of the various resource inputs of the Department of Justice and the South African Police Service in ultimately determining crime prevention. The summary statistics of the relevant Department of Justice variables are presented in Table F.1 in Appendix F on page 274. Presently this is the best that can be done with the information provided and the Department of Justice will be excluded from the rest of the analysis. The Department of Correctional Services will also necessarily be excluded.

From the international production function literature reviewed in the previous section important proxy variables were identified. For each production function variable the South African Police Service was only able to provide information on one operational statistic that could be used as a proxy. The exception is capital inputs, for which information was provided regarding computers and vehicles. As there is no choice to be made between variables to be used as appropriate proxies, all of the information will be used in the analysis and will be described in the next section when the models are specified. Where separate operational information has been provided relating to Head Office activities, it will be apportioned to the provinces in proportion to the number of provincial personnel. It must be re-emphasized that throughout the South African criminal justice system, and particularly within the Department of Justice, statistics and the format in which they are collected need to be revised, so that they do not impose severe limitations on empirical analyses. If this is done, it will be possible to estimate more extensive and detailed models. It will also be possible to empirically assess from a number of variables, which are the best proxies to use. However, currently, this cannot be done.

Using the data provided by the South African Police Service, it is possible to conduct a national production function study at provincial level using quarterly data from mid 1996 to

the end of 1999. Pooled data, that is data disaggregated over time and in terms of geographical area, will be used in the empirical estimation of the production function models. In order to accommodate the timing of criminal justice processing, it is assumed that there is a six month delay from the reporting of crime until police processing is complete and cases go to court, if they do. This assumption was also adopted in the empirical analyses conducted in previous chapters in this thesis. No research has been done regarding this delay but it has been estimated, over the 1997 to 1999 period, that on average awaiting trial prisoners waited 115 days before appearing in court. It is important to note that production function models with a lag structure address the issue of reverse causality. In South Africa police resources are allocated nationally and therefore resources are likely to be apportioned to geographical areas in terms of policing output. The inherent difficulty of determining causation in such circumstances is obvious but in this study this is dealt with by incorporating a six month time lag.

The provincial and quarterly crime statistics provided by the South African Police Service only relate to the twenty serious categories of crime prioritized nationally, therefore the crime statistics used in the South African Police Service production function models in this study do not correspond directly with those used in the analyses in Chapters Three and Four. Only the following crimes are included in the total crime policing production function analysis: murder, attempted murder, robbery with aggravated circumstances (with firearms), robbery with aggravated circumstances (without firearms), other robberies, rape of children (0 - 17 years), rape of adults, assault with the intent to inflict grievous bodily harm, common assault, burglary of business premises, burglary of residential premises, stock theft, shoplifting, theft of motor vehicles and motorcycles, theft from motor vehicles, other thefts, arson, malicious damage to property, all fraud, malappropriations, embezzlements *et cetera*, illegal possession of firearms and drug-related crime. Driving under the influence of substances is excluded as it is a minor offence. In Chapters Three and Four all crimes recorded in the Human Science Research Council's crime data base, excluding misdemeanors, were considered in the analyses of total crime. The crimes considered in the property crime policing production function correspond exactly with those included in the property crime analyses in earlier chapters. Similarly the crimes considered in the

violent crime policing production function correspond with those included in the preceding violent crime analyses, the only exception being the inclusion of the crime category murder² in the production function analysis.

Unfortunately policing operational information provided regarding labour input, capital inputs and additional variables does not relate specifically to different types of crime. Nonetheless a distinction will be made between the different types of crime in the modeling, in order to ascertain whether or not there is a difference in the resource inputs which are effective in the prevention of the different categories of crime. A similar approach was adopted in Chapter Four when the determinants of the crime rate were empirically estimated.

In addition to the information provided by the South African Police Service, provincial information regarding mid-year estimates of population size was obtained from Statistics South Africa and land area in square kilometers from the Department of Land Affairs. By applying a growth formula, the annual population size data was used to estimate the quarterly population size.³ This was used in the calculation of the population density per square kilometer.

The difficulties associated with obtaining appropriate data to analyze South African criminal justice system productivity have been indicated above. However, it is reassuring to note from the review of international literature in the above section that many of the studies have proceeded with estimation on the basis of a similar data set to that which has been assembled for the purposes of this study. Indeed, by comparison, most of the other studies also did not consider a number of proxies for each production function variable. In addition, the best practice estimation procedures outlined in the section on international literature are mostly replicable in the South African case.

5.4 SPECIFICATION OF THE MODEL

Production function models for the South African Police Service will be estimated. The international literature reviewed at the beginning of this chapter must be referred to in order

to correctly specify the South African models. From Table 5.1 it is evident that in all of the studies, a log-linear functional form was adopted in the empirical analyses of production functions. Gujarati (1995:214-217) shows that this functional form is related to the Cobb-Douglas production function, which is well-known in production theory. Formally the model is presented in its stochastic form as follows:

$$Y_{it} = \beta_0 L_{it}^{\beta_1} K_{it}^{\beta_2} e^{u_{it}} \quad (5.1)$$

where Y = output

L = labour input

K = capital input

u = stochastic disturbance term

e = base of natural logarithm

i = observation

t = time

From equation 5.1 it is clear that the relationship between output and resource inputs is nonlinear. The model can, however, be log-transformed to obtain a model that is linear in the parameters and in the logarithms of the variables (Gujarati 1995:165). The result is a log-linear model:

$$\ln Y_{it} = \ln \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln K_{it} + u_{it} \quad (5.2)$$

where ln = natural log

The parameters of equation 5.2 can be estimated using the ordinary least squares method (Gujarati 1995:166). Expressed in this way, the model has the following properties. The slope coefficients measure the elasticity of output with respect to the relevant resource input, that is, the percentage change in output resulting from a change of one percent in the resource input, *ceteris paribus*. In terms of this model specification, constant elasticity estimates are obtained. The intercept term is a biased estimate because when β_0 is estimated as the antilog of the estimator of $\ln \beta_0$, it is a biased estimator (Gujarati 1995:166). However, this is not of concern as no economic meaning is attached to the intercept. The sum of the slope coefficients is an indicator of the returns to scale, the effect on output of a proportionate change in all resource inputs. If the sum is less than one then

there are decreasing returns to scale, if it is equal to one there are constant returns to scale and above one it is an indicator of increasing returns to scale (Gujarati 1995:215). In terms of this model specification, the returns to scale are not restricted to being constant. However, it is assumed that the marginal productivity of resource inputs decrease from the outset. In order to allow the marginal product of each input to rise initially, before falling; the transcendental production function model, a generalization of the Cobb-Douglas model, would need to be used.

Darrough and Heineke point out that the inclusion of a workload variable 'is a substantial departure from a neoclassical approach in which the shape of the production function itself will reflect diminishing returns as capacity is pressed' (1978:261). The inclusion of this variable in empirical research is 'based upon the restrictiveness of the chosen functional forms [(log-linear)] and a consequent attempt on the part of the authors to provide output responses which do vary with the scale of operation, in functions which do not naturally possess this property' (Darrough & Heineke 1978:265). For the purposes of this study, a workload variable will therefore need to be included in the production function model in order to conform to internationally recognised best practice. A population size variable will also be included in the model, as a 'measure of "scale"' (Darrough & Heineke 1978:265).⁴

As no other researcher has estimated a policing production function model within the South African context, the model specification should be as general as possible considering data availability. For this reason an additional variable, which accounts for differences in labour productivity, is included in the model. In Chapter One on page 16, where the South African criminal justice system was discussed, it was noted that dissatisfaction with policing largely results from the small size of the police force and the inefficiency of officers. Therefore the capacity of labour input must be considered in addition to the number of officers employed. The South Africa Foundation specifically indicated the need for more experienced staff (1996:38). The extended production function model may be formally presented as follows:

$$\ln Y_{it} = \ln \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln K_{it} + \beta_3 \ln W_{it} + \beta_4 \ln P_{it} + \beta_5 \ln E_{it} + u_{it} \quad (5.3)$$

where W = workload

P = population size

E = expertise of labour force

When data availability was assessed on page 173 it was noted that capital input information on both motor vehicles and computers could be used in production function modelling. As the motor vehicle fleet can be considered as the stock of fixed capital in a traditional sense, whereas computer capacity is an indicator of technological input, both variables have been included in the production function equation. This is in keeping with the general principle adopted that the specification should be as all encompassing as possible. For the same reason a population size variable has been included - either population density or population number, depending on which is most significantly correlated with policing output. According to Cameron (1991:315) population density and population size are both indicators of the general operational environment within which criminal justice system outputs must be produced. As these two variables are proxies of the same factor (Cameron 1991:316), only one of them will be included in the production function equation in this study.

The equation modelling the production of the South African Police Service output may be written as follows:

$$\ln \text{probcort}_{it}^* = \beta_0 + \beta_1 \ln \text{people}_{it} + \beta_2 \ln \text{compexp}_{it} + \beta_3 \ln \text{motorex}_{it} + \beta_4 \ln \text{totalcr}_{it}^* + \beta_5 \ln \text{popsize}_{it} + \beta_6 \ln \text{serveys}_{it} + u_{it} \quad (5.3')$$

A list of the variables to be used in the estimation of equation 5.3' is set out in Table 5.2 below. The variables indicated with an asterisk in the equation are replaced with identical variables which relate specifically to, either property crimes, or violent crimes when policing productivity in relation to property crime and violent crime is respectively estimated. When the regression results are given in Tables 5.3, 5.5 and 5.6 this exchange of variables will be evident. In Table 5.2 it can be seen that in some cases the number of resource inputs have been included, while in others expenditure on inputs have been used; however, the

proxy for labour input is number of personnel. Fortunately this information is available because on page 171 above concern was expressed regarding the use of personnel expenditure as a variable in production function equations.

Table 5.2: Proxy Variable Categories and Abbreviations

Variable Name	South African Police Service Proxy Variables
Output (Y)	Probability of Prosecution, given Total Crime (probcort) Probability of Prosecution, given Property Crime (propcort) Probability of Prosecution, given Violent Crime (violcort)
Labour Input (L)	Departmental Personnel Number (people)
Capital Input (K) ⁵	Departmental Real Expenditure on Computers (compexp) Departmental Real Expenditure on Vehicles (motorex)
Workload (W)	Number of Total Crimes (totalcr) Number of Property Crimes (propcr) Number of Violent Crimes (violcr)
Population Size (P) (popsize)	Population Number (pop) OR Population Density Per Square Kilometer (popdense)
Expertise of Labour Force (E)	Departmental Average Years of Service (serveyrs)

When pooled data is used three different model specifications may be applicable in empirical analysis; the classical linear regression model, the fixed effects model or the random effects model (Greene 1997:614-615). The classical regression model estimates the coefficients of the variables in the equation, without considering that the data set is pooled. The classical regression model relating to South African policing is presented on the previous page as equation 5.3'. This model will be the most appropriate one if provincial and time effects are absent. The fixed effects model includes dummy variables to account for provincial and/or time effects. Essentially three fixed effects specifications must be considered; one including time effects only, another including provincial effects only and a final one including both provincial and time effects (Greene 1997:615-622). These are presented as follows:

$$\ln \text{probcort}_{it}^* = \beta_0 + \beta_1 \ln \text{people}_{it} + \beta_2 \ln \text{compexp}_{it} + \beta_3 \ln \text{motorexp}_{it} + \beta_4 \ln \text{totalcr}_{it}^* + \beta_5 \ln \text{popsize}_{it} + \beta_6 \ln \text{serveyrs}_{it} + \beta_7 \text{time2}_{12} + \beta_8 \text{time3}_{13} + \beta_9 \text{time4}_{14} + \beta_{10} \text{time5}_{15} + \beta_{11} \text{time6}_{16} + \beta_{12} \text{time7}_{17} + \beta_{13} \text{time8}_{18} + \beta_{14} \text{time9}_{19} + \beta_{15} \text{time10}_{110} + \beta_{16} \text{time11}_{111} + \beta_{17} \text{time12}_{112} + u_{it} \quad (5.3'-1)$$

$$\ln \text{probcort}_{it}^* = \beta_0 + \beta_1 \ln \text{people}_{it} + \beta_2 \ln \text{compexp}_{it} + \beta_3 \ln \text{motorexp}_{it} + \beta_4 \ln \text{totalcr}_{it}^* + \beta_5 \ln \text{popsize}_{it} + \beta_6 \ln \text{serveyrs}_{it} + \beta_7 \text{prov2}_{2t} + \beta_8 \text{prov3}_{3t} + \beta_9 \text{prov4}_{4t} + \beta_{10} \text{prov5}_{5t} + \beta_{11} \text{prov6}_{6t} + \beta_{12} \text{prov7}_{7t} + \beta_{13} \text{prov8}_{8t} + \beta_{14} \text{prov9}_{9t} + u_{it} \quad (5.3'-2)$$

$$\ln \text{probcort}_{it}^* = \beta_0 + \beta_1 \ln \text{people}_{it} + \beta_2 \ln \text{compexp}_{it} + \beta_3 \ln \text{motorexp}_{it} + \beta_4 \ln \text{totalcr}_{it}^* + \beta_5 \ln \text{popsize}_{it} + \beta_6 \ln \text{serveyrs}_{it} + \beta_7 \text{time2}_{12} + \beta_8 \text{time3}_{13} + \beta_9 \text{time4}_{14} + \beta_{10} \text{time5}_{15} + \beta_{11} \text{time6}_{16} + \beta_{12} \text{time7}_{17} + \beta_{13} \text{time8}_{18} + \beta_{14} \text{time9}_{19} + \beta_{15} \text{time10}_{110} + \beta_{16} \text{time11}_{111} + \beta_{17} \text{time12}_{112} + \beta_{18} \text{prov2}_{2t} + \beta_{19} \text{prov3}_{3t} + \beta_{20} \text{prov4}_{4t} + \beta_{21} \text{prov5}_{5t} + \beta_{22} \text{prov6}_{6t} + \beta_{23} \text{prov7}_{7t} + \beta_{24} \text{prov8}_{8t} + \beta_{25} \text{prov9}_{9t} + u_{it} \quad (5.3'-3)$$

Note that one province and/or time period is not included as a dummy variable because it serves as the basis for comparison in detecting province or time effects. One of these models will be best if there are provincial and/or time effects in the functions. The random effects model is used if data is not available for all the provinces and/or time periods under consideration. In this case a provincial and/or time random component would be present in the error term of the model and the specification would have to change to account for this (Greene 1997:623-632). In this study this is not the case and therefore the random effects models do not have to be considered.

To summarise, in this study the production function analysis will be conducted by estimating equation 5.3' for each of the three categories of crime considered in this study. A pooled data set will be used relating to the nine South African provinces and to twelve time periods, the quarters from 1997 to 1999. Either classical linear regression models or fixed effects models will be estimated using this pooled data, depending on which model specification is shown to be best after statistical comparison of the results. As Cobb-Douglas production functions will be modeled, a log-linear functional form will be adopted. This specification of the models is in line with those used in the studies reviewed in the international literature.

The ordinary least squares, as opposed to the two stage least squares, procedure will be used in the estimation of the models in this study. This approach is necessitated by South African data availability. Table 4.2 on page 115 lists the law enforcement, economic and socio-economic variables which influence the South African crime rate, the workload variable in the policing production function (Table 5.2 on page 179). Unfortunately economic and socio-economic information is only available on an annual and not a quarterly basis and therefore, even though the number of crimes is an endogenous variable, the use of a two stage least squares approach in the production function analyses is not possible as the sample size is too small. In Chapter Four on page 122 the results of Hausman specification tests using cross-sectional data for crime committed in 1994 were given⁶, they clearly showed, with a 99 percent level of confidence, that simultaneity exists in the equation systems of the three crime models. That is, re-stated for purposes of this chapter, the number of crimes is an endogenous regressor within the policing production function equations in the South African context and ideally the two stage least squares estimation procedure would have been preferable. It should be noted that the use of the ordinary least squares procedure in the estimation of the models, when the two stage least squares procedure is appropriate, implies that the endogenous variable in the production function equation is correlated with the disturbance term (Gujarati 1995:670, Pindyck & Rubinfeld 1991:303).

Some changes may need to be made to the data set and/or the models prior to the commencement of the actual regression analyses in order to improve the results. To this end the extent of multicollinearity between model variables must be determined and the variable descriptive statistics must be examined for irregularities. On inspection it was noted that for one observation, relating to the Eastern Cape in the first quarter of 1998, a negative sign is attached to real police expenditure on computers - presumably this is the case because of a reversal of a previous accounting entry. When this variable was log-transformed, a missing value was generated. This is the only missing value in the data set. As the remaining number of observations is big enough, it was not considered necessary to derive a value which could be imputed or to exclude the variable in policing production function analyses.

It was ascertained that there are complex relationships between the variables in the data set owing to underlying trends. When considering the three policing production function models, it can be stated with a 99 percent level of confidence that in all cases the independent variables, except for the variable average years of service, are correlated with output. The output variable and average years of service are also significantly correlated, in the: total crime model with a 95 percent level of confidence, property crime model with a 99 percent level of confidence and violent crime model with a 90 percent level of confidence. Although multicollinearity is observed in the data set, models were not changed by transforming or dropping any of the variables as there are no theoretical grounds for doing this. It is important to note that this is generally the approach adopted in other studies, despite the fact that multicollinearity results in substantially higher standard errors and lower t-statistics, as well as unexpected changes in the magnitude and signs of coefficients.

Before the actual regression analyses can be performed, as mentioned above on page 178, it is necessary to decide on the population size variable which will be included in the models. In the case of all three policing production function models, both population number and population density per square kilometer are correlated with policing output with a 99 percent level of confidence. However, population density will be used as the proxy for population size because in the total crime and violent crime models it is more significant when the numerical value for $P > |t|$ is considered.

5.5 ESTIMATION OF THE MODELS

Table G.1 in Appendix G on page 275 provides the summary statistics of the variables in the South African Police Service model. Having implemented the above changes, it was necessary to decide on the model specification to be adopted before proceeding with the regression analyses. In line with the approach adopted in Chapter Four, the methodology employed in this study in the estimation of the three crime models was standardised. As the total crime model is broader, it is used to make decisions regarding the estimation procedures to be adopted and the other production function models are dealt with accordingly. For the policing total crime production function, the classical linear regression model and all the fixed effects models were estimated. Equation 5.3' on page 178 and

equations 5.3'-1, 5.3'-2 and 5.3'-3 on page 180 were compared by systematically considering two of the models using the F-test⁷, until only the most appropriate one remained. In this manner it was determined that the fixed effects model including provincial and time effects is the most appropriate for estimating policing production functions.⁸ That is, equation 5.3'-3 will be used in the estimation of the production function models. Table 5.3 below indicates the regression results for the production function equations relating to each of the crime models. The results indicated in the Total Crime (2) and Violent Crime (2) columns in Table 5.3 should be ignored at this stage as they will be discussed later in this section.

Table 5.3: Fixed Effects Results for the South African Police Service Production**Function Equation**

	<u>Total Crime</u>	<u>Total Crime(2)</u>	<u>Property Crime</u>	<u>Violent Crime</u>	<u>Violent Crime(2)</u>
intercept	+52.38442 (5.261)***	(4.538)***	+69.16309 (5.682)***	+35.3378 (3.069)***	(3.289)***
people	-4.193288 (-3.579)***	(-2.815)***	-5.961187 (-4.142)***	-2.551503 (-1.840)*	(-1.645)
compexp	-0.0488132 (-1.740)*	(-2.531)**	-0.0692685 (-2.044)**	-0.0357301 (-1.062)	(-1.776)*
motorexp	+0.0274176 (0.718)	(0.825)	+0.0400719 (0.858)	+0.0037509 (0.082)	(0.085)
totalcr	-1.163203 (-5.996)***	(-6.643)***			
propcr			-0.9147867 (-4.126)***		
violcr				-1.252501 (-5.981)***	(-5.925)***
popdense	+0.3072894 (0.162)	(0.150)	-0.4165352 (-0.180)	+0.4991126 (0.221)	(0.223)
serveyrs	+0.0172099 (0.071)	(0.061)	+0.0301399 (0.103)	+0.119836 (0.407)	(0.378)
prov2	-2.573612 (-2.737)***	(-2.910)***	-3.751848 (-3.299)***	-1.733269 (-1.537)	(-1.877)*
prov3	+1.920586 (0.448)	(0.432)	+4.568952 (0.876)	+0.3404323 (0.066)	(0.070)
prov4	+0.8066734 (0.514)	(0.495)	+1.7643 (0.924)	+0.0354799 (0.019)	(0.020)
prov5	-5.057283 (-4.659)***	(-3.622)***	-6.5518 (-4.922)***	-3.708747 (-2.923)***	(-2.625)***
prov6	-3.139578 (-5.694)***	(-5.020)***	-4.174724 (-6.228)***	-2.16547 (-3.363)***	(-3.779)***
prov7	-7.283911 (-1.643)	(-1.686)*	-11.81084 (-2.196)**	-4.200414 (-0.792)	(-0.910)
prov8	-3.434138 (-3.924)***	(-3.039)***	-4.41305 (-4.066)***	-2.226555 (-2.213)**	(-1.947)*
prov9	-1.09788 (-3.242)***	(-3.174)***	-1.89025 (-4.580)***	-0.8253186 (-2.051)**	(-2.536)**
time2	-0.0557447 (-1.418)	(-1.194)	-0.0225203 (-0.503)	-0.0938216 (-1.618)	(-1.570)
time3	-0.1678711 (-2.176)**	(-2.330)**	-0.1958705 (-2.101)**	-0.1521722 (-1.600)	(-1.530)
time4	-0.2042865 (-2.352)**	(-2.545)**	-0.2817151 (-2.672)***	-0.1740145 (-1.675)*	(-1.889)*
time5	-0.2654193 (-2.541)**	(-2.649)***	-0.3706927 (-2.911)***	-0.1724621 (-1.372)	(-1.499)
time6	-0.4236294 (-3.191)***	(-3.272)***	-0.5086344 (-3.172)***	-0.3647201 (-2.218)**	(-2.330)**
time7	-0.417676 (-2.519)**	(-2.666)***	-0.4835175 (-2.402)**	-0.3771518 (-1.884)*	(-2.085)**
time8	-0.3142061 (-2.261)**	(-1.934)*	-0.387244 (-2.289)**	-0.2484416 (-1.505)	(-1.423)
time9	-0.3283093 (-2.053)**	(-1.888)*	-0.4470342 (-2.305)**	-0.230647 (-1.204)	(-1.149)
time10	-0.3927432 (-2.349)**	(-2.156)**	-0.4748219 (-2.352)**	-0.3458357 (-1.698)*	(-1.601)
time11	-0.3605316 (-2.015)**	(-1.814)*	-0.4669973 (-2.155)**	-0.2882572 (-1.336)	(-1.269)
time12	-0.5447271 (-2.079)**	(-2.164)**	-0.8089212 (-2.547)**	-0.3289928 (-1.048)	(-1.117)
N	107	107	107	107	107
R ²	0.9482	0.9482	0.9327	0.9416	0.9416
Adjusted R ²	0.9322		0.9120	0.9236	
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000

* T-statistics are in parenthesis. Significance at $\alpha = 0.01, 0.05$ and 0.10 are indicated by ***, ** and * respectively.

Ultimately diagnostic analyses were performed on the above production function models. It was necessary to determine whether heteroscedasticity was present in any of the models. For each regression a graphical plot of the squared residuals against the predicted values for the dependent variable was considered. This informal test indicates the presence of heteroscedasticity if any systematic pattern between the two variables is identified (Gujarati 1995:368-369). Heteroscedasticity was not evident as none of the crime models displayed a clearly recognisable systematic pattern. However, this was analyzed formally using the Cook-Weisberg test, which is based on squared standardised residuals (Hamilton 1998:169).

For the policing property crime model it was found that, with a 95 percent level of confidence, the null hypothesis of constant error variance could not be rejected ($\text{Prob} > \chi^2 = 0.1146$). The null hypothesis was, however, rejected for the policing total crime model ($\text{Prob} > \chi^2 = 0.0005$) and violent crime model ($\text{Prob} > \chi^2 = 0.0000$). The White method was used to correct for the heteroscedasticity in these models and the resultant t-statistics and significance levels are reflected in the Total Crime (2) and Violent Crime (2) columns in Table 5.3. After correction these models are adequate as their P -values are small, indicating that the null hypothesis that the estimated coefficients of all the parameters are zero can be rejected, and the R^2 remains identical. Therefore the results can be considered reliable and can be included in the analysis.

The residuals of the regressions also had to be considered. In all of the three crime models it was noted that the residuals were equally positive and negative when they were plotted against the predicted values. Although this suggests normal distributions in all of the models, this was formally tested using the skewness-kurtosis test (Hamilton 1998:100-101). In the policing total crime model, with a 95 percent level of confidence, the null hypothesis of normality could not be rejected, normality was indicated in the skewness statistic ($P = 0.048$) and in the kurtosis statistic ($P = 0.011$). This was also the case for the policing property crime model, where for the skewness statistic $P = 0.028$ and the kurtosis statistic $P = 0.013$, and for the violent crime model, where for the skewness statistic $P = 0.162$ and the kurtosis statistic $P = 0.059$. It was also necessary to determine whether the mean value of

the residuals of the regressions approximated zero. This was true of all of the models. In the total crime model the mean of the residuals was $1.17e-10$, in the property crime model $-1.60e-10$ and in the violent crime model $3.70e-11$.

5.6 INTERPRETATION OF RESULTS AND COMPARISON WITH OTHER STUDIES

In order to meaningfully interpret the outcomes of the South African policing production function models, it is necessary to compare them with the results obtained in the international studies described at the beginning of the chapter. For ease of comparison, the results of this research are shown together with the findings of the reviewed studies in tabular form. The statistics from the international literature have been disaggregated and separate tables have been created displaying the information pertinent to overall crime, property crime and to violent crime. The production functions relating to each crime type will be discussed in turn.

A log-linear functional form was adopted in all of the production function models considered in the international studies included in this research. Cameron (1991) is the only author that estimated models using other functional forms in addition to log-linear equations. Only the log-linear model results are shown in the comparative tables presented below, for the sake of consistent comparison. Cameron (1991:315), however, emphasises that similar findings may be the result of using a similar functional form for the production function equation. The particular crimes included in each study within the property and violent crime categories are specifically mentioned in Tables 5.5 and 5.6 below, respectively. In keeping with the practice adopted throughout this study, robbery has been included in both the property crime and violent crime categories (refer to page 42 in Chapter One). In all the studies, except the one undertaken by Chapman et al. (1975), the policing output measure is the clearance rate.⁹ Chapman et al. (1975) employed five measures of output for which results are indicated separately in Table 5.5. These measures are comprised of different weightings of two output indicators, the arrest rate and the estimated crime prevented rate. It should be noted that both Pogue (1975) and Cameron (1991) did not provide information on the level of significance attached to variables that are not viewed as policing inputs, therefore these results could not be included in the significance result summary. The

missing information is indicated in the comparative tables by a question mark. It is also important to note that in most instances information regarding the goodness of the fit of the regression was not provided and therefore it could not be included in the tables.

Many of the independent variables included in the production function models in this research had to be excluded for purposes of economic interpretation. The variables explaining the time and provincial effects were all excluded as policy recommendations in this regard would not be meaningful. Likewise, the intercept in this and other studies was not considered as it holds information on all the important variables not included in the model and therefore no specific recommendations can be made concerning it. In production function studies the intercept is often interpreted as an indicator of technical change. However, given that this approach was not adopted in the studies reviewed and that computer capacity was included in this study as an indicator of technological input, this interpretation of the intercept was not considered appropriate.

Firstly the policing total crime model will be discussed, thereafter the property crime model and finally the violent crime model. Table 5.4 below summarises the regression outcomes of all the studies that were concerned with total crime. The variables specified in the Variables column are those that were used in this study.

Table 5.4: Regression Results for the Policing Total Crime Production Function

Variables	Pogue (1975)	Burrows and Tarling (1982)	Positive/ (Significant)	Negative/ (Significant)	Brown (2001)
Personnel Number (people)		Police Per Capita +0.15	one (zero)	zero (zero)	-4.193, significant
Real Expenditure on Computers (compexp)			zero (zero)	zero (zero)	-0.049, significant
Real Expenditure on Vehicles (motorexp)			zero (zero)	zero (zero)	+0.027, insignificant
Number of Total Crimes (totalcr)	Estimated Crime Rate +0.009,7	Crime Rate -0.36, Significant Crimes with More than 75% Clearance Rate as a Percentage of All Crime +0.63, Significant Indictable Crimes Per CID and Uniform Officer -0.46, Significant Indictable Crimes Per CID Officer -0.44, Significant Indictable Crimes Per All Police Officers -0.49, Significant	two (one)	four (four)	-1.163, significant
Population Density Per Square Kilometer (popdense)	Population Density Per Square Mile (thousands) -0.117,? Total Population (thousands) +0.094,?	Total Population -0.39, Significant	one (zero)	two (one)	+0.307, insignificant

Variables	Pogue (1975)	Burrows and Tarling (1982)	Positive/ (Significant)	Negative/ (Significant)	Brown (2001)
Average Years of Service (serveys)		Proportion of Force CID -0.27	zero (zero)	one (zero)	+0.017, insignificant
Additional Variables	Estimated Per Capita Expenditure on Policing (dollars) -0.114 Estimated Per Capita Law Enforcement Expenditure (thousands of dollars) -0.144	Proportion of Male Population Aged 15 - 24 -0.32, Significant Proportion of Area Urban -0.25 Proportion Unemployed +0.04 Average Weekly Earnings -0.19 Proportion Middle Class +0.06 Proportion Working Class +0.15 Expenditure on the Police Per Officer -0.34, Significant			
Adjusted R ²					
R ²	0.198				

From the previous section describing the production function model specification, it was noted on page 176 that the regression coefficients obtained in the studies are constant elasticity estimates, which indicate the percentage change in output that results from a one percentage change in the resource input. These estimates inform appropriate resource allocation policy as they provide information regarding the relative importance of input variables in determining policing output. However it is not reasonable to assume that the numerical values of the estimation coefficients are directly comparable across studies, although the signs and levels of significance attached to estimation coefficients can be compared. According to Pogue (1975:33), '[f]urther comparison and reconciliation of these results is difficult because the studies employ different measures ... , units of observation and control (environmental) variables'.

Implicitly it is expected that the signs on resource input coefficients will be positive, that is that the relationships between policing inputs and output display the positive marginal productivity of inputs. In studies which employ the log-linear functional form, the traditional production function has been extended to include scale variables (refer to page 177) and these are generally expected to have negative signs on their estimated coefficients. The workload variable is assumed to be negatively related to output because increases place larger and larger constraints on resource capacity. Similarly, large populations make law enforcement more difficult. (Darrough & Heineke 1978:261,263) Darrough and Heineke (1978:261-262) note that the "fisheries argument" is sometimes used to explain the relationship between workload and output - if the number of crimes is large, it is easier to clear-up a crime than if there is only a very small number of crimes.

From Table 5.4 it can be seen that the outcomes of this study indicate that the variables *motorex*, *popdense* and *serveyrs* have positive signs on their estimated coefficients. Where the variables were tested in the other studies reviewed, these results do not correspond with the majority of the other findings. However, real expenditure on vehicles and average years of service are indicators of police resource inputs, fixed capital and the expertise of officers respectively, and are therefore expected to be positively related to the probability of securing a prosecution (*probcort*). It is evident that in the South African Police

Service increasing the number of vehicles has a greater influence on output than proportional increases in the average number of years of service. Population density is a scale variable and in terms of the hypothesis above it is expected to be negatively related to policing output. Yet it was noted in Chapter Three on page 95 that Howsen and Jarrel (1987:454-455) postulated that the relationship between population density and the probability of prosecution is positive initially, owing to increased law enforcement capacity and increased familiarity among people. Therefore, theoretically it must also be acknowledged that population density could be positively related to policing output.

Surprisingly many of the explanatory variables displayed negative signs on their coefficients - people, compexp and totalcr. All of these variables are also significant determinants of the probability of prosecution. Of the variables that were tested by other empirical researchers, only the workload variable has the same sign indicated by the results of the majority of studies. Therefore as is normally the case, in the South African context increases in the scale of operation place a capacity constraint on output and the 'fisheries argument' is clearly not applicable.

Personnel number and real expenditure on computers represent the policing inputs of labour and technology respectively. Their negative relationship with policing output indicates the negative marginal productivity of these resources. That is, additional employees and additional computer equipment appear to reduce overall productivity. In terms of production function theory this occurrence is normally attributed to the fact that too many of these inputs are being employed, given the level of employment of other resource inputs. In Section 1.3 in Chapter One on pages 16 and 17 it was noted that the number of these inputs employed in South African policing is not excessive by international standards. Yet it is not completely surprising that these inputs do not appear to be productive. Given the operational changes taking place in the department related to its post-apartheid transformation, this is most probably associated with a general lack of knowledge regarding the new institutional environment. Pogue (1975:24&33) notes that even if efficiency improves in some areas, crime may be diverted to other areas of less effective law enforcement and therefore in aggregate terms a lack of productivity remains problematic.

As long as, on aggregate, police officers and computer technology do not appear to be effective, increases in these resources cannot be used as instruments for improving the probability of prosecution. However, '[t]hese findings do not imply that police spending [of this nature] could be drastically curtailed without increasing crime' (Pogue 1975:39).

As noted on page 178 above, in this study capital input was included as a separate factor of production and it was further defined by including two measures, an indicator of fixed capital, real expenditure on vehicles, and one of technology, real expenditure on computers. This detailed approach was not adopted in any of the other research reviewed and it is therefore necessary to conduct a F-test on the variable subset in order to ensure that the variables in the subset influence output. From the test it was determined that this subset does influence the probability of prosecution, with a 95 percent level of confidence ($\text{Prob}>F=0.0206$). The joint null hypothesis that the subset variables collectively make no contribution towards explaining policing output can be rejected.

On page 176 in Section 5.4 it was indicated that the returns to scale, the resultant output change when changing all resource inputs by the same proportion, can be determined by summing the estimated regression coefficients relating to resource inputs. The sum of the coefficients of the input variables people, compexp and motorex is -4.215. Following Intriligator et al. (1996:292-293) the estimated coefficients of labour productivity variables are not included in the returns to scale calculations as they merely augment the labour input measure.¹⁰ Decreasing, constant or increasing returns to scale are not applicable in South African policing, however, negative returns to scale are. From this it must be concluded that the negative marginal productivity relating to the employment of labour and computers greatly outweighs the productivity gain relating to the employment of vehicles. In the other two studies considered negative returns to scale were also observed, the sum of the input coefficients was -0.258 in Pogue's analysis and -0.190 in that of Burrows and Tarling. It should be noted that the expenditure on input variables used in these studies, which are indicated in the additional variables row in Table 5.4, were included in the calculation.

Below the policing production function relating to property crime in South Africa will be analyzed. Table 5.5 contains the results of all the studies that considered productivity regarding property crime policing, including the present study.

Table 5.5: Regression Results for the Policing Property Crime Production Function

Variables	Chapman et al. (1975)	Pogue (1975)	Cameron (1991)
Personnel Number (people)	<p>Number of Motorcycle Officers</p> <p>1- +0.01</p> <p>2- +1.21, Significant</p> <p>3- +2.02, Significant</p> <p>4- +2.82, Significant</p> <p>5- +4.32, Significant</p> <p>Number of Field Officers</p> <p>1- +0.718, Significant</p> <p>2- +0.55</p> <p>3- +1.24, Significant</p> <p>4- +1.93, Significant</p> <p>5- +3.24, Significant</p> <p>Number of Nonfield Officers</p> <p>1- +1.02, Significant</p> <p>2- -1.31</p> <p>3- -2.12</p> <p>4- -2.89</p> <p>5- -4.32</p> <p>Number of Civilian Employees</p> <p>1- +0.74, Significant</p> <p>2- +1.80, Significant</p> <p>3- +2.60, Significant</p> <p>4- +3.34, Significant</p> <p>5- +4.72, Significant</p>		<p>Police Officers Per Capita</p> <p>+0.45, Significant</p> <p>Police Officers Per Capita Multiplied by the</p> <p>Logarithm of Police Officers Per Capita</p> <p>-4.39, Significant</p>
Real Expenditure on Computers (compexp)			
Real Expenditure on Vehicles (motorexp)			
Number of Property Crimes (propcr)		<p>Estimated Crime Rate</p> <p>Robbery -0.100,?</p> <p>Burglary -0.101,?</p> <p>Larceny -0.436,?</p> <p>Motor Theft -0.478,?</p>	<p>Per Capita Number of Property Crimes</p> <p>-0.33,?</p>

Table 5.5 continued

Variables	van Tulder (1999)	Positive/ (Significant)	Negative/ (Significant)	Brown (2001)
Personnel Number (people)		seventeen (fifteen)	five (one)	-5.961, significant
Real Expenditure on Computers (compexp)		zero (zero)	zero (zero)	-0.069, significant
Real Expenditure on Vehicles (motorexp)		zero (zero)	zero (zero)	+0.040, insignificant
Number of Property Crimes (propcr)	Number of Crimes Petty Thefts +0.86, Significant Aggravated Thefts +0.93, Significant	two (two)	five (zero)	-0.915, significant

Table 5.5 continued

Variables	Chapman et al. (1975)	Pogue (1975)	Cameron (1991)
Population Density Per Square Kilometer (popdense)		Population Density Per Square Mile (thousands) Robbery -0.108, [?] Burglary -0.098, [?] Larceny -0.040, [?] Motor Theft -0.175, [?] Total Population (thousands) Robbery +0.003, [?] Burglary +0.075, [?] Larceny +0.155, [?] Motor Theft +0.220, [?]	Population Density -3.34, [?] Total Population -5.9, [?]
Average Years of Service (serveyrs)			
Additional Variables	Number of Newly Released Prisoners 1- +0.078 2- -0.62, Significant 3- -1.03, Significant 4- -1.41, Significant 5- -2.14, Significant Structural Change Dummy Variable 2- -0.61, Significant 3- -0.84, Significant 4- -1.07, Significant 5- -1.48, Significant	Estimated Per Capita Expenditure on Policing (dollars) Robbery +0.005 Burglary -0.106 Larceny -0.026 Motor Theft -0.202 Estimated Per Capita Law Enforcement Expenditure (thousands of dollars) Robbery +0.099 Burglary -0.055 Larceny -0.246 Motor Theft +0.071	
Adjusted R ²			
R ²	1- 0.9013 2- 0.8827 3- 0.8321 4- 0.7729 5- 0.6957	Robbery 0.064 Burglary 0.090 Larceny 0.109 Motor Theft 0.234	

Table 5.5 continued

Variables	van Tulder (1999)	Positive/ (Significant)	Negative/ (Significant)	Brown (2001)
Population Density Per Square Kilometer (popdense)		four (zero)	six (zero)	-0.417, insignificant
Average Years of Service (serveys)		zero (zero)	zero (zero)	+0.030, insignificant
Additional Variables	Real Labour and Material Costs Petty Thefts +0.14, Significant Aggravated Thefts +0.07 Technical Developments Time-trend Variable Petty Thefts -0.03, Significant Aggravated Thefts -0.04, Significant Scale effects Trend Variable Petty Thefts +0.02 Aggravated Thefts -0.02 Police Reorganization Dummy Variable Petty Thefts +0.01 Aggravated Thefts +0.03			
Adjusted R ²	Petty Thefts 0.53 Aggravated Thefts 0.66			
R ²	Petty Thefts 0.57 Aggravated Thefts 0.69			

In the policing property crime model the variable *propcr* replaced the variable *totalcr*. Where variables were tested in the other property crime studies considered, the majority of the results obtained corresponded exactly with those obtained in the total crime research reviewed. In the discussion of the total crime model the differences between these results and those of this study were noted. The signs and significance of the estimated coefficients remained the same for all of the variables in the South African property crime model, except *popdense*. For all of these variables the explanations given in the total crime productivity analysis remain valid, as does the conclusion. In order to increase the probability of prosecution (*propcort*), albeit for property crimes, most importantly the vehicle fleet should be increased. Retaining employees to increase the level of expertise in the police force will also improve policing output. However, merely increasing the number of personnel and computerization is not effective, operational changes are necessary. This is emphasized when the contribution of these resources to the existing negative returns to scale is noted. The sum of property crime policing input coefficients is -5.990.

This returns to scale result does not correspond with that in the majority of other property crime productivity studies. In all of the five production function equations estimated by Chapman et al. increasing returns to scale were observed. For the equation indicated by 1 in Table 5.5 the returns to scale indicator was +2.488, for 2 it was +2.250, for 3 it was +3.740, for 4 it was +5.200 and for 5, +7.960. Cameron's empirical analysis indicated negative returns to scale for property crimes, the appropriate statistic was -3.940. In Pogue's research negative returns to scale were shown for burglary (-0.161), larceny (-0.272) and motor theft (-0.131). However, a value of +0.104 for robbery implies decreasing returns to scale. In the study by van Tulder decreasing returns to scale were also evident, for both petty thefts (+0.110) and aggravated thefts (+0.030). The expenditure on input variables in the additional variables row in the table were included in the calculations for Pogue and van Tulder. The technology variable in the same row was also included in the calculations for van Tulder. It is important to note that the South African result does correspond with that of Cameron, the only other researcher who considered property crime as a broad category.

The variable population density is negatively related to the probability of prosecution for property crimes, although it is still an insignificant output determinant. This result is confirmed by the majority of research articles reviewed, irrespective of crime categorization. Given this result, it must be concluded that increased population density makes law enforcement regarding property crimes more difficult, as is generally hypothesized. A F-test was performed on the capital input variable subset containing compexp and motorex and it was determined that this entire subset does influence the probability of property crime prosecution, with a 90 percent level of confidence ($\text{Prob}>F=0.0823$).

Finally the policing violent crime model will be analyzed. Table 5.6 displays the results of all the research reviewed that considered violent crime law enforcement and also includes the results of this study.

Table 5.6: Regression Results for the Policing Violent Crime Production Function

Variables	Pogue (1975)	Cameron (1991)
Personnel Number (people)		Police Officers Per Capita -0.94, Significant Police Officers Per Capita Multiplied by the Logarithm of Police Officers Per Capita +0.13, Significant
Real Expenditure on Computers (compexp)		
Real Expenditure on Vehicles (motorex)		
Number of Violent Crimes (violcr)	Estimated Crime Rate Robbery -0.100,? Murder +0.033,? Rape -0.163,? Aggravated Assault +0.037,?	Per Capita Number of Violent Crimes -8.51,?
Population Density Per Square Kilometer (pepdense)	Population Density Per Square Mile (thousands) Robbery -0.108,? Murder -0.012,? Rape +0.042,? Aggravated Assault -0.026,? Total Population (thousands) Robbery +0.003,? Murder -0.015,? Rape -0.059,? Aggravated Assault -0.095,?	Population Density -3.93,? Total Population +7.34,?
Average Years of Service (servyrs)		
Additional Variables	Estimated Per Capita Expenditure on Policing (dollars) Robbery +0.005 Murder +0.022 Rape -0.014 Aggravated Assault -0.059 Estimated Per Capita Law Enforcement Expenditure (thousands of dollars) Robbery +0.099 Murder -0.118 Rape -0.221 Aggravated Assault +0.080	
Adjusted R ²		
R ²	Robbery 0.064 Murder 0.180 Rape 0.280 Aggravated Assault 0.159	

Table 5.6 continued

Variables	van Tulder (1999)	Positive/ (Significant)	Negative/ (Significant)	Brown (2001)
Personnel Number (people)		one (one)	one (one)	-2.552, insignificant
Real Expenditure on Computers (compexp)		zero (zero)	zero (zero)	-0.036, significant
Real Expenditure on Vehicles (motorexp)		zero (zero)	zero (zero)	+0.004, insignificant
Number of Violent Crimes (violcr)	Number of Violent Crimes +0.98, Significant	three (one)	three (zero)	-1.253, significant
Population Density Per Square Kilometer (popdense)		three (zero)	seven (zero)	+0.499, insignificant
Average Years of Service (serveyrs)		zero (zero)	zero (zero)	+0.120, insignificant
Additional Variables	Real Labour and Material Costs +0.02 Technical Developments Time-trend Variable -0.01 Scale effects Trend Variable -0.01 Police Reorganization Dummy Variable -0.05, Significant			
Adjusted R ²	0.83			
R ²	0.85			

As with the property crime model, the policing violent crime model will be compared to the total crime model. In the violent crime model the variable violcr was used instead of totalcr. For the variables which were tested in the other violent crime studies considered, the majority of the results obtained were similar to those obtained in the total crime studies. Most of the differences between these results and the outcomes of this study were mentioned in the above discussion regarding the total crime model. In the other violent crime research reviewed, however, for the labour input and workload variables an equal number of outcomes were positive and negative. Although the only significant workload variable observed was positive, this corresponds with the findings of the other property crime research in which two variables were significant and also positive. All the signs on the estimated coefficients were the same in the violent crime model, nonetheless compared to the total crime model the labour input variable lost significance.

For all of the variables the explanations provided in the total crime analysis remain the same. However, the conclusion is slightly altered. The probability of a violent crime prosecution (violcort) is increased more by an increase in the expertise of officers, than by a proportional increase in the vehicle fleet. Increases in the number of officers and computers do not improve crime policing output, and this remains true when violent crimes are considered. Given the greater importance of investigation skills and lesser importance of transportation in combating violent crimes, it is understandable that the F-test conducted on the capital input variable subset reveals that the joint null hypothesis, that the variables collectively make no contribution towards explaining the probability of prosecution, could not be rejected. As $\text{Prob}>F=0.2094$ it is evident that the capital input variables do not significantly influence violent crime policing output. Although the serveyrs variable is also not a significant determinant, irrespective of the crime category considered, it appears to have been appropriate to extend the traditional production function to accommodate its inclusion because the expertise of officers is shown to be a policing policy instrument which can be used to improve the probability of securing prosecution.

Negative returns to scale are also evident in relation to the policing of violent crimes in South Africa. The sum of the estimated coefficients for the violent crime policing inputs;

people, compexp and motorex is -2.584. This corresponds with Cameron's findings, the appropriate value in his study being -0.810. However Cameron is not the only author who considered violent crime as a broad category. Van Tulder did too and he observed decreasing returns to scale (+0.010). In Pogue's research decreasing returns to scale were displayed for robbery (+0.104) and aggravated assault (+0.021) but there were negative returns to scale for murder (-0.096) and rape (-0.235). In the calculations the expenditure on input and technology variables in the additional variables row in Table 5.6 were included in the results of Pogue and van Tulder.

Briefly the findings regarding policing productivity in South Africa can be summarized as follows. For all categories of crime the probability of prosecution is negatively related to the number of crimes. As hypothesized, an increased workload places constraints on policing capacity. The negative relationship between population density and property crime policing output indicates that increases in population make law enforcement regarding these crimes more difficult. For other crime categories, however, population density is positively related to output. It was noted that this may be owing to the increased law enforcement capacity and/or familiarity among people that is related to living in a more densely populated area.

From the other negative estimated coefficients, it is evident that for all crime types increases in the number of officers employed and expenditure on computers will not add to average productivity. They ultimately result in the negative returns to scale observed for policing in South Africa. This appears to be related to significant operational changes. Real expenditure on vehicles and average years of experience of officers are positively related to policing output, irrespective of the category of crime considered. For total crime and property crime, policing effectiveness can be improved by increasing expenditure on the vehicle fleet firstly and then by increasing the number of experienced officers retained in service. Effectiveness in violent crime policing can be improved most by using experienced officers and also by increasing the number of vehicles available. F-tests on the capital input variable subsets containing compexp and motorex show that these variables are significant determinants of policing output, except for in the case of violent crimes.

5.7 POLICY RECOMMENDATIONS

In the above section all the South African policing production function models were analyzed in detail in order to assess the relative importance of the various resource inputs in determining output. The resource allocation policy implications for the South African Police Service were spelled out. In this section the relationship between departmental resource inputs and the crime rate must be considered.

In Chapter One and the introduction to this chapter it was noted that the aim is to determine the relationships between specific resource inputs in criminal justice system departments and the crime rate, in order to be able to compare the relative effects on crime of proportional changes in the numerous inputs in the departments. After conducting more thorough research regarding the South African criminal justice system in this chapter, it is evident that only the relationships between policing resource inputs and the crime rate can be ascertained in this study. In Table 3.1 on page 83 the probability of punishment variables considered as determinants of the South African crime rate were noted; the probability of conviction, the primary output of the Department of Justice, could not be included as no information was available in this regard. On pages 172 and 173 in the data audit section of this chapter it was noted that not enough detailed information was provided and therefore that a production function analysis of this department, relating inputs to the probability of conviction, could not be performed. On page 172 it was also noted that, owing to the lack of prison output data, a production function analysis of the Department of Correctional Services could not be conducted. It should also be recognized that the recidivism rate, the proposed indicator of prison output, was not considered as a determinant in the crime rate functions estimated in Chapter Four. Unfortunately owing to the data restrictions imposed on the empirical estimation of both the crime rate and production functions by the departments of Justice and Correctional Services, it is not possible to assess the relative importance of the resource inputs in these departments in determining the crime rate using these functions in a nested model. As a result, the crime reduction effects of the criminal justice system as an integrated entity cannot be considered.

The relationships between South African Police Service resource inputs and the South African crime rate must be determined for each of the crime categories. However, it should be noted that many of the explanatory variables considered in the interpretation of the production function results in the section above had to be excluded. The scale variables, number of crimes and population density, were not included as they were introduced to overcome the limitations of log-linear analysis (Darrough & Heineke 1978:261-265) and do not result in resource allocation policies which can be readily implemented. The labour input and technology variables, personnel number and real expenditure on computers, also had to be excluded because they have negative signs on their estimated coefficients, indicating the negative marginal productivity of these resources. After the process of elimination, the variables in Table 5.7 below remained and represent those for which it was feasible to perform further calculations.

Table 5.7: Crime Prevention Effects of South African Policing Inputs

	Total Crime	Property Crime	Violent Crime
Elasticity of the Probability of Prosecution with Respect to:			
motorexp	(1) (0.0274176)	(1) (0.0400719)	(2) (0.0037509)
serveys	(2) (0.0172099)	(2) (0.0301399)	(1) (0.119836)
Elasticity of the Crime Rate with Respect to:			
probcort	-0.2894854	-0.3825369	-0.4353642
Elasticity of the Crime Rate with Respect to:			
motorexp	(1) -0.007937	(1) -0.0153289	(2) -0.001633
serveys	(2) -0.004982	(2) -0.0115296	(1) -0.0521723
Percentage Change Required to Reduce the Crime Rate by One Percent:			
motorexp	(1) 126	(1) 65	(2) 612
serveys	(2) 201	(2) 87	(1) 19

* Insignificant determinants are indicated in parenthesis. The determinants are numbered in order of effectiveness.

The elasticity estimates of the other research reviewed for the purposes of this study were not included for comparison as the numerical values of the estimation coefficients are not directly comparable. The elasticities relating to the policing production functions are shown again in row three of the table. They are taken directly from Table 5.3 on page 184. In order to calculate the elasticities relating the relevant policing resource inputs to the crime rate, the elasticities in row three must be considered together with the elasticity of the crime rate with respect to the probability of prosecution for each crime category. This information regarding the intermediary crime rate functions was provided in Table 4.8 on page 156 in Chapter Four and is noted in row five of Table 5.7. It must be emphasized that ideally the production and crime rate functions required for the calculations should have been

estimated in the same way. In the section describing the production function model specification, however, it was noted on page 181 that this was not possible.¹¹ Although this situation is not ideal, the two estimated functions will be used together as this is the best that can be done given the data availability constraints.

For each category of crime the elasticity of the probability of prosecution with respect to each policing input (in row three in Table 5.7) was multiplied by the elasticity of the crime rate with respect to the probability of prosecution (in row five of the table), in order to relate policing inputs to the crime rate. In row seven of the table the elasticities of the crime rate with respect to particular policing inputs are indicated. For total crime and property crime it is evident that increases in the police vehicle fleet (motorex) have a greater crime reduction influence than increases in the number of experienced police officers employed (serveyrs). Accordingly consideration should be given to allocating resources to these inputs in terms of their effectiveness in decreasing crime of a particular category. However, it is important to note that South African policing inputs generally have a very small effect on decreasing crime. A one percent increase in the number of police vehicles will reduce the overall crime rate by 0.007937 percent, whereas a one percent increase in the average years of experience of officers will decrease the total crime rate by 0.004982 percent. A one percent increase in the vehicle fleet or in the average years of officer experience will reduce property crime by 0.0153289 percent or 0.0115296 percent respectively. An increase in the years of service of officers has a greater impact on decreasing violent crime than an increase in the number of vehicles available to police officers. One percent increases in these inputs, respectively, result in South African violent crime decreasing by 0.0521723 percent and 0.001633 percent respectively. The relative effectiveness of these inputs must be considered when resources are allocated to reduce violent crime.

Ultimately the effectiveness in terms of manipulating policing resource inputs to achieve a given decrease in the crime rate must be ascertained. For the purposes of this study it was decided to target a one percent reduction in crime. The percentage increase required in police inputs to bring about a one percent decrease in the crime rate is indicated in row nine

of Table 5.7. These percentages were calculated by dividing the number one by the elasticities in row seven of the table.

Again it is apparent that for total crime and property crime increasing the vehicle fleet is most effective in reducing crime. For a one percent overall crime reduction, a 126 percent increase in police vehicles is required and for the same property crime reduction, a 65 percent increase is needed. Increasing the average years of experience of officers is less effective in bringing about a one percent decrease in crime, the increase required is 201 percent for overall crime and 87 percent for property crime. As noted above, increases in average years of officer experience are more effective in reducing violent crime, albeit by one percent, than increases in the vehicle contingent. A 19 percent increase and a 612 percent increase are required in the inputs respectively.

Throughout this section the policy conclusions regarding resource allocation for effective crime reduction correspond exactly with those obtained in the previous section relating to policing resource allocation. Given that it was noted above that the effectiveness of the resource inputs of the departments of Justice and Correctional Services regarding crime reduction could not be considered, this is expected. Linking the productivity of police resource inputs to the crime rate for different categories of crime, by using the relevant elasticity of the crime rate with respect to the probability of prosecution, resulted in the appropriate changes in numerical values but did not change the ranking of inputs in terms of their relative effectiveness.

As noted in Chapter One on page 40 in recent years a disproportionately large percentage of total South African police expenditure has been directed at personnel, yet it was also noted that no substantial and sustained decreases in the South African crime rate have been observed. From the elasticity estimates in Table 5.3 on page 184 it is evident that the policing labour input variable, personnel number, displays considerable negative marginal productivity, irrespective of the crime category considered. The technology variable, real policing expenditure on computers, also appears to be ineffective in reducing crime. However in this table and Table 5.7 on page 206 above, it is shown that the expertise of the

labour force, as measured by average years of police service, and the vehicles employed, real expenditure on vehicles, are police resource inputs that effectively decrease the crime rate of all categories of crime. From this it must be concluded that more police personnel inputs are not most effective in reducing crime. For total crime and property crime increasing the vehicle fleet is most effective. For violent crime prevention the most effective input is police officer experience. This verifies the secondary hypothesis in this study; namely, that more expenditure on departmental personnel is not most effective in preventing South African crime.

5.8 CONCLUSION

At the beginning of this chapter it was emphasized that the focus of the analysis would be narrowed, in order to assess the performance of the criminal justice system in greater detail using empirical methods. To this end international crime production function literature was reviewed. Unfortunately no other South African authors have conducted empirical studies considering productivity in the criminal justice system. In the literature surveyed important modelling issues were raised and it was concluded that the majority of these can be suitably addressed in this South African study. The specification of the production function models and the data used in this chapter are in line with accepted best practice employed in the studies considered.

Data was obtained directly from the relevant departments comprising the criminal justice system and therefore it is reasonably reliable. It was possible to construct a pooled data set for the quarters of 1997 to 1999, using provincial data. The data used in earlier chapters was obtained from secondary sources and analyses were confined to the short-term, a cross-sectional data set at magisterial district level relating to 1994 crime was used. Even though in this chapter analyses over the medium term are possible, limitations are imposed by data availability. The biggest constraint is the lack of appropriate information in respect of both the departments of Justice and Correctional Services, which ultimately prohibits empirical production function analyses of these departments. The operational information provided by the South African Police Service only relates to the twenty crimes prioritized

nationally and because of this the crime statistics used do not correspond exactly with those used in previous chapters.

In order to ascertain the effectiveness of the various resource inputs in determining output so that appropriate resource allocation policy recommendations could be made, production functions were specified for the South African Police Service for overall crime, property crime and violent crime. In each case a log-linear functional form was adopted in the specification of the Cobb-Douglas production function. The other studies reviewed also adopted this approach. Traditionally in economic theory these production functions include a labour and capital input variable, although the empirical studies considered did not always include both. Some of these researchers did, however, include workload and population size variables as measures of scale because log-linear models do not inherently allow for variations in scale of operation. As production functions have never been estimated for South African policing, the model specification used was as general as possible given data availability. Measures of scale were included, along with two measures of capital input, one of fixed capital and the other of technology, and a measure of the expertise of employees. The probability of prosecution was used as the measure of South African Police Service output. Given data constraints this was the only output variable that could be considered, although it was possible to define it appropriately in terms of crime category.

The Hausman specification tests carried out in Chapter Four indicated that the probability of prosecution is an endogenous right hand side variable in the equation determining the South African crime rate. Conversely in the policing production functions, the number of crimes, the workload variable, is an endogenous variable in the equation determining the probability of prosecution. Therefore two stage least squares procedures should have been adopted in estimating the policing production function models. However, this was not possible owing to the unavailability of data. As the economic and socio-economic data regarding the variables determining the endogenous variable is not available on a quarterly basis, ordinary least squares procedures had to be adopted in estimation.

Before the production function models could be estimated it was necessary to make further decisions regarding their specification. After considering the significance levels of the Pearson pairwise correlations, the variable population density was identified as the most appropriate population size variable to use when compared to the population number variable. The total crime policing production functions were estimated using the classical linear regression and fixed effects estimation procedures. Time and/or provincial effects were included in the three fixed effects models considered. F-tests were used to systematically compare two of the models and it was determined that the fixed effects model including time and provincial effects is the most appropriate. Therefore, this model specification was used in the estimation of production functions relating to all categories of crime.

The models were then estimated and diagnostic analyses were performed on them. The Cook-Weisberg test indicated that heteroscedasticity was present in the policing total crime and violent crime models. The White method was applied to correct this and it was found that the models are adequate and that any conclusions drawn from these results can be considered reliable.

The estimation results obtained for each of the South African policing production function models could be compared to the results obtained in other studies. In many instances the results of this study did not correspond with the findings in the majority of other studies reviewed. However, in most cases they did correspond with the findings of at least one other researcher that had tested the variable. For all models the results were compared to the predicted outcomes in terms of production function theory. In most instances the results of this study were explicable but an alternative theory was put forward to explain the positive sign on the variable popdense, which was evident in the total crime model and the violent crime model.

When considering the variables in the production functions which do relate directly to the resource input allocation decisions which are made by the South African Police Service, the findings are as follows. For all crime types increasing the number of officers employed and

expenditure on computers detracts from output as these variables display negative marginal productivity. Ultimately negative returns to scale are observed for policing in South Africa, irrespective of the crime category considered. It appears that this is related to the significant operational changes taking place within the policing environment. For all categories of crime expenditure on vehicles and average years of experience of officers are positively related to policing output. From the elasticity estimates it is evident that for total crime and property crime, policing effectiveness can be improved most by increasing expenditure on the vehicle fleet and then by increasing the number of experienced officers in employment. Effectiveness in violent crime policing can be improved most by using experienced officers and also by increasing the number of vehicles available. F-tests on the capital input variable subsets indicate that these variables are significant determinants of policing output, except in the case of violent crimes. From the above it is evident that the inclusion of the capital input variables and the variable measuring labour force expertise in this study was not superfluous.

Ultimately it was necessary to determine the relationships between departmental resource inputs and the crime rate, in order to ascertain the effectiveness of the various inputs in preventing South African crime. For this a nested model, using the crime rate function as an intermediary function, was used. It should be noted that the crime rate functions in Chapter Four were used for this purpose, although it was noted that they were not estimated in exactly the same way as the production functions. Unfortunately, owing to the limitations of the data provided regarding the departments of Justice and Correctional Services, it was not possible to include them in the nested model.

As the nested model only includes the South African Police Service, it is not surprising that the conclusions regarding appropriate resource allocation to effectively reduce South African crime correspond exactly with those relating to policing. For total and property crime, the most effective input in decreasing crime is vehicles. The experience of police officers is also effective. The most effective input in reducing violent crime is officer expertise and vehicles are less effective. It is important to note that South African policing inputs generally have a very small effect on decreasing crime. The labour input and

technology input variables were excluded in this analysis at the outset. As they are not effective in determining policing output, they remain ineffective when policing output is related to the crime rate. It must, therefore be concluded that the secondary hypothesis in this study is verified in respect of policing, more expenditure on personnel is most certainly not effective in preventing crime. The percentage change in the inputs required to bring about a one percent reduction in the crime rate was calculated and the results were verified for all categories of crime. The increase required in the most effective variable was less than the increase required of the other variable which decreases crime.

Although empirical estimates are never perfect and the results of this productivity study are limited in numerous ways, they should assist in the assessment of policy alternatives, which up to the present time has been based on descriptive operational analyses. It should, however, be noted that the costs of the various inputs were not considered at all as this study was focussed on the effectiveness of inputs in determining output and ultimately crime prevention. Clearly the cost-effectiveness of proposed changes in inputs must be considered before final decisions can be made in this regard. It should also be noted that although the analyses in this chapter are adequately comparable to those in the other international studies considered, the South African results appear dismal. Especially when considering that labour input appears to be ineffective and that computerization does not appear to increase output. Within the South African law enforcement environment apparent reasons for these outcomes can be found. It is widely acknowledged that the information technology infrastructure within the criminal justice system is not suitable and the State Information Technology Agency is currently making the necessary improvements, although the appropriate changes will take a few years to implement. However, it is important to consider that the production function results are based on aggregate level data. The use of less aggregated data, relating to police stations in the case of the South African Police Service, is more appropriate for informing decision-making regarding resource allocation policy. Using this approach it will be possible to specifically identify units and compare the marginal productivity of inputs. In this study only the aggregate marginal productivity of inputs could be assessed. As detailed micro level data is not available this approach was

necessitated. It is, however, imperative that the quality of information be improved if policy-making is to be more effective.

NOTES:

1. Information is only available for each quarter for the years of 1997 to 1999. Twelve observations is too few for an empirical analysis using pooled data.
2. Refer to the tenth footnote in Chapter Three on page 102.
3. The growth rate between two annual population size estimates was calculated as follows:

$$g = ((I_t / I_{t-1})^f - 1) \times 100, \text{ where } f = 1$$

where g = annualized growth rate

I = population size estimate

$t-1$ = earlier period

t = latter period

f = frequency of time series per annum (Mohr 2000:46-47).

Once this had been determined, the quarterly population size estimates were calculated for the three interim quarters by changing the subject of the formula as follows:

$$I_t = (((g/100) + 1)^{1/f}) \times I_{t-1}, \text{ where } f = 4$$

and applying this formula consecutively.

4. Population size variables were discussed when the international empirical literature was reviewed on page 171.
5. In order to calculate real expenditure on capital input, the Gross Domestic Product deflator was used to control for inflationary effects. The Gross Domestic Product deflator was calculated by dividing quarterly nominal Gross Domestic Product by quarterly real Gross Domestic Product.
6. In order to conduct Hausman specification tests the relevant economic and socio-economic data are needed. As this is not available on a quarterly basis, these tests

cannot be conducted on the pooled data analyzed in this chapter and therefore reference is made to the cross-sectional data used in Chapter Four.

7. According to Greene (1997:617) the test involves determining whether $F^* = ((SSE_1 - SSE_2)/k)MSE_2 > F(v_1, v_2)$, where
 SSE_1 and SSE_2 = sum of squared residuals for models 1 and 2 respectively (model 1 is the nested model)
 k = number of β parameters in model 2, excluding β_0
 MSE_2 = mean of squared residuals for model 2
 v_1 = additional β coefficients tested in model 2
 $v_2 = n - (k+1)$
 n = total sample size.
 If $F^* > F(v_1, v_2)$, model 2 is preferred.
8. Testing the South African Police Service total crime models:
 Classical regression model (equation 5.3') compared to fixed effects model, including time effects (equation 5.3'-1):
 $F^* = ((2.40630952 - 2.0300729)/11)/0.022809808 = 1.499500964$
 $F_{0.05}(11, 90) = 1.896669488$ and $F_{0.01}(11, 90) = 2.451258752$
 $F^* < F(11, 90)$, therefore equation 5.3' is preferred.
 Classical regression model (equation 5.3') compared to fixed effects model, including provincial effects (equation 5.3'-2):
 $F^* = ((2.40630952 - 0.508872872)/8)/0.005531227 = 42.88010255$
 $F_{0.05}(8, 93) = 2.039541869$ and $F_{0.01}(8, 93) = 2.708532065$
 $F^* > F(8, 93)$, therefore equation 5.3'-2 is preferred.
 Fixed effects model, including provincial effects (equation 5.3'-2) compared to fixed effects model, including provincial and time effects (equation 5.3'-3):
 $F^* = ((0.508872872 - 0.377980949)/11)/.004666431 = 2.549971429$
 $F_{0.05}(11, 82) = 1.907423552$ and $F_{0.01}(11, 82) = 2.471921334$
 $F^* > F(11, 82)$, therefore equation 5.3'-3 is preferred.

9. Burrows and Tarling (1982:5-7) emphasise that use of the clearance rate as an output measure is controversial because this statistic can be manipulated by police officers. They therefore tested the correlation between different definitions of clearance and the official clearance statistic. However, they concluded that the use of the official statistic is a robust measure in their study.
10. In an example of a Cobb-Douglas production function relating to medical practices, Intriligator et al. include the coefficient of the variable measuring the number of physicians in the returns to scale calculation but exclude that of the variable measuring the number of hours worked.
11. The production function analyses were performed over the medium-term, 1997 to 1999, using pooled data but the analyses of the determinants of the South African crime rate could only be conducted over the short-term. In Chapters Three and Four cross-sectional magisterial district data relating to crime committed in 1994 was considered and two stage least squares estimation procedures were adopted. As noted from Chapter Three on pages 83 and 84 annual data regarding the economic and socio-economic variables which influence crime is available. As no quarterly estimates exist it was not possible to conduct crime rate analyses over the medium-term using pooled data as the number of annual observations is too few, given that the crime statistics provided for 1997 to 1999 were not made available for smaller units of analysis than provinces.

CHAPTER SIX

CONCLUDING REMARKS AND ADDITIONAL RECOMMENDATIONS

6.1 SUMMARY

In Chapter One it was noted that crime in South Africa has been increasing rapidly over time and that the level of crime is high by international standards. Yet no empirical research has been conducted to determine the relative importance of the numerous causes of South African crime and address the associated issue concerning the types of public expenditure that will be effective in preventing crime. Nor has any other researcher focussed on ascertaining empirically the contribution that various South African criminal justice system resource inputs make towards the system output or examining the accompanying issue regarding the crime reduction impact of different inputs. This, despite the fact that the debate regarding South African crime prevention has centred around improving the effectiveness and efficiency of the system. "[Action] must replace words; knowledge must replace fascination" (United States of America President's Commission by Reid 1988:351).

On a macro level crime influences international economic relations and is often cited as the reason for South Africa's inability to attract more foreign capital and tourists. On a micro level crime constitutes a direct attack on public order and safety. In addition to its direct effects on victims, including businesses and the government, crime has secondary effects related to the psychological fear of crime which is experienced by the entire population.

Internationally it is recognised that it is the duty of the government to protect society from crime and in South Africa and worldwide, almost exclusively, the criminal justice system has been used for this purpose. However, nationally and internationally crime continues to increase despite increased criminal justice system expenditure on crime prevention. There are many criticisms of the South African criminal justice system, which relate to the efficiency and fairness of operations within the various departments and to the coordination of activities within the entire system. Currently the criminal justice system

does not appear to be an effective deterrent to crime and there is much debate about how the system should be improved.

It is possible to argue that in South Africa the law enforcement activities of the criminal justice system are not deterring crime because the system is inefficient and not because deterrence is an inappropriate crime prevention policy. However, many social science authors have argued that the deterrent effects of the criminal justice system are less important than the effects of changes in some economic and socio-economic variables on the crime rate. They advocate social-problems approaches to crime as opposed to the traditional opportunity-reduction approaches because they believe that crime is predominantly 'poverty-induced' and not 'prosperity-induced'. Public opinion surveys in South Africa have indicated that the major causes of crime are believed to be economic in nature. Therefore the central hypothesis in this study is that more public expenditure exclusively on the criminal justice system is not the most effective crime prevention policy for South Africa. Crime prevention will be more effective when use is also made of the types of public expenditure that relate to the significant economic and socio-economic variables influencing crime.

In order to incorporate the influences of other economic and socio-economic variables, it is necessary to develop a broader theory of crime and this was done in Chapter Two. The Neoclassical economic theory of crime is, however, retained as the framework within which to develop a broader interdisciplinary theory of crime as it is most appropriate because it is best able to weigh all the influences of the criminal justice system on crime as well as the influences related to additional economic and socio-economic variables.

The aggregate level economic model of the market for offences was used as opposed to the individual level model because the focus is on general deterrence and the determinants of crime in South Africa. The supply of offences is a positive function of the return from criminal activities, which is positively related to the benefits from criminal activities and negatively related to the costs associated with such activities. The demand for offences is derived from the demand for safety and is therefore a negative function

of the return from criminal activities. Increases in the return from criminal activities bring forth increases in the number of offences. This increases the demand for safety and conversely, reduces the demand for offences. The demand for offences is comprised of three components: the derived private and public demands for offences and the demand of the buyers of illegal goods and services.

Traditionally economists using this model have concentrated on the law enforcement variables and have advocated deterrence to prevent crime. Essentially increases in the probability of punishment and/or the cost of the median sentence, which reduce both the demand for and supply of offences, have been recommended because it was believed that criminal justice system expenditure impacts solely on crime, whereas other types of public expenditure also affect other individuals in society who do not have criminal dispositions. Nationally and internationally, a shift in the public and academic debate away from deterrence and therefore alternative means of improving the effectiveness of criminal justice system operations is essential if effective crime prevention policies are to be implemented. This can only be achieved if an integrated approach to crime causation theory is adopted.

Therefore an interdisciplinary theory of crime causation based on the economic theory of crime was developed, including important aspects of the sociological structure and radical criminology theories. Essentially the effects of the following variables on the net earnings from legitimate activities were incorporated within the interdisciplinary theory: income, the unemployment rate, educational achievement, age, race and gender. The effects of the following variables on the net earnings from illegitimate activities were also included: age, gender, economic development, family instability, deviant subcultures, criminal associations, population density and powerful societal groups. As a result of this interdisciplinary approach which is more sophisticated, much more insight is gained regarding the variables that can be manipulated in order to raise the net earnings from legitimate activities and/or reduce the net earnings from illegitimate activities in order to prevent crime. The focus is no longer exclusively on raising the expected punishment costs associated with committing crime. Therefore in terms of the interdisciplinary

theory, it possible to assess the merits of both traditional policy practices and theories as well as alternative proposals.

Having identified important crime causation variables from the interdisciplinary theory, a range of South African proxy variables were considered in Chapter Three, which included inequality measures as well as traditional measures of the level of a variable. The variables used were mainly derived from information provided by the Human Science Research Council's Geographic Information System, specifically the crime data base and the October Household Survey data base. Information from the 1995 Income and Expenditure Survey conducted by the Central Statistical Service (now Statistics South Africa) was also used. The information provided by the Department of Correctional Services, in Justice Department publications and by the provincial offices of the South African Police Service was not in geographical information system format and had to be adjusted accordingly.

An aggregate level study of a cross-section of magisterial districts in 1994 was undertaken to explain the total crime, property crime and violent crime rates. Property crimes were included as a separate category because the majority of South African crime falls within this category and this type of crime is increasing faster than any other. Violent crimes were studied separately because they are high by international standards and growing. The Pearson pairwise correlation coefficients of all the proxy variables were calculated for each type of crime and it was decided to retain one variable in each variable category for formal modelling purposes, the one which had the highest level of significance attached to the correlation coefficient.

In Chapter Four international literature was reviewed and it was concluded that the specification of the three crime rate models in this study is in line with the specifications employed in the empirical studies considered. A simultaneous demand-and-supply equation system was not used as the objective in this study is not to determine the optimal quantity of offences, return from criminal activities or probability of punishment. Rather the object is to ascertain the determinants of crime in South Africa, therefore in each of the crime rate models a hybrid reduced-form equation, containing elements of

both the demand for and the supply of offences, was used. After considering the stepwise regression results relating to the probability of prosecution variable and conducting Hausman specification tests, it was established that the probability of prosecution is an endogenous variable in the reduced-form crime rate equation in all three models. Given the simultaneity in the equation systems, two stage least squares estimation procedures were adopted to estimate the coefficients of the parameters of the equation systems. From these estimated coefficients elasticity estimates of the crime rates with respect to explanatory variables were calculated. However, as a cross-sectional data set was used it was not possible to consider unobserved heterogeneity.

In Chapter Five the focus was narrowed as it only concerns the criminal justice system, which has an inherent role to play in a society based on the rule of law. A production function analysis was performed, in order to empirically assess the relative importance of various resource inputs in the criminal justice system in determining output. In recent years in criminal justice system departments the proportion of expenditure devoted to personnel has continued to grow, although this expenditure is disproportionately high. Yet South African crime continues to increase. Therefore the secondary hypothesis in this study is that more personnel expenditure in the departments of the criminal justice system is not most effective in preventing South African crime.

The data considered in this chapter was obtained directly from the departments in the South African criminal justice system. From international literature reviewed various production function proxy variables were identified. However, information was only provided regarding one operational statistic that could be used as a proxy for each production function variable. A pooled data set at provincial level for the quarters of 1997 to 1999 was constructed.

Policing production functions were specified for total crime, property crime and violent crime. Their specification is in line with the specifications used in the international empirical studies considered. In each case a log-linear functional form was adopted in the specification of the Cobb-Douglas production function. It was noted that it is most likely that the right hand side workload variables in the production function equations are

endogenously determined. But as economic and socio-economic data regarding variables which determine the workload variables are not available on a quarterly basis, ordinary least squares estimation procedures were adopted in the estimation. Population number and population density were compared in terms of the significance levels of the Pearson pairwise correlations and it was established that population density is the most appropriate population size variable to include in the production functions. F-tests were used to compare the outcomes of the total crime policing production functions estimated using the classical linear regression and fixed effects estimation procedures. It was determined that the fixed effects model including time and provincial effects is the most appropriate and it was adopted in estimation, therefore unobserved heterogeneity was accounted for.

Ultimately the relationships between policing resource inputs and the South African crime rates were ascertained. For this a nested model, using the crime rate functions estimated in Chapter Four as intermediary functions, was used. The percentage change in the inputs required to bring about a one percent reduction in the crime rate were also noted.

6.2 FINDINGS

In the preliminary analyses conducted in Chapter Three the Pearson pairwise correlation coefficients relating to explanatory variables were determined and it was found that no one category of variables completely explains any of the categories of crime considered. The law enforcement, socio-economic and economic variables all explain crime in South Africa to some extent. The economic variables appear to be the most important category of variables and the education variables, particularly, are greatly significant.

Alternative theories, which can be accommodated within the framework of the interdisciplinary theory of crime causation, were proposed to explain the negative signs on the Gini coefficient variable and the variable measuring the proportion of the population residing in an urban area. Howsen and Jarrel's (1987) rationale that the relationship between population density and the crime rate is negative at first and later becomes positive was adopted in this study. The increased population density,

accompanying urbanisation in its early stages, results in increased law enforcement capacity and familiarity among people and this deters crime to some extent. In order to explain the negative relationship between the crime rate and the Gini coefficient, it was postulated that the differences in income status among potential criminals within society hinder their ability to form criminal associations.

As described in the above section, in Chapter Four more sophisticated empirical models were developed to explain the causes of the different types of crime. It was established that heteroscedasticity was present in the violent crime model and the White method was applied to remedy this. However after applying this procedure, the model was shown to be unreliable and therefore no conclusive recommendations can be made regarding violent crime in South Africa. Yet it does appear as if the probability of prosecution may deter this type of crime.

When comparing this study to the other empirical studies it was found that more explanatory variables were considered in this study, owing to the inclusion of many inequality measures and economic variables relating to race and gender. F-tests on the variable subsets relating to each variable category in the total and property crime models indicated that with at least a 95 percent confidence level the variable subsets all contributed to explaining the crime rate, therefore the inclusion of the additional variables was appropriate. However, the following variables were found to be bad proxies for what they intended to measure and had to be excluded for purposes of interpretation: average length of prison sentence, average number of years of education, Black and Coloured to Others ratio of proportion with primary school education, female to male gender ratio, female to male ratio of median income and female median income. Median income was a bad proxy only in the case of property crime.

The estimation results obtained in this study were compared to the results obtained in other studies and it was determined that in most cases, except in the property crime model, they did not correspond. However, in most instances at least one other researcher had obtained the same results. Once again the urbanisation variable was negatively related to all categories of crime and Howsen and Jarrel's theory in this

regard was assumed to be valid. The Gini coefficient was negatively related to property and violent crime and the theory propounded in Chapter Three appears to be relevant for explaining these crimes. The variables measuring average age and the proportion of young people in the population had the wrong signs in all the crime models. It was therefore contended that in South Africa the average age of criminals is probably higher and that most crime is not being committed by juvenile delinquents.

F-tests were conducted on the broad law enforcement, economic and socio-economic variable subsets. The conclusion reached in Chapter Three was supported as the tests indicated that, with the exception of violent crimes, with a 99 percent confidence level all variable categories influence the crime rate significantly. This corresponds with the findings of Howsen and Jarrel (1987) and Meera and Jayakumar (1995), who explicitly were concerned with the relative importance of different variable categories in determining the crime rate.

In Chapter Five empirical production function models were estimated for South African policing, relating to total crime, property crime and violent crime. Cook-Weisberg tests indicated that heteroscedasticity was present in the total crime and violent crime models. The White method was applied to correct this and it was found that the models are adequate and that any conclusions drawn from the results can be considered reliable.

When this study was compared to the other international studies, it was evident that the South African production function models include more independent variables. The model specification used was as general as possible and therefore included measures of scale and capital input and a measure of the expertise of employees. F-tests on the capital input variable subsets indicated that these variables are only significant determinants of total crime and property crime output, with a 95 and 90 percent level of confidence respectively. Although capital inputs were not found to be significant determinants of violent crime output, the inclusion of these variables in policing production functions appears to be appropriate. It also appears to be appropriate to include the statistically insignificant measure of labour force expertise because it displays positive marginal productivity in all the policing functions.

The results obtained in this study of policing productivity were compared to the results obtained in the international studies considered. It was determined that in many instances the results in this study did not correspond with the other research findings. However, in most cases they did correspond with the findings of at least one other researcher that had tested the variable. For all models the results were also compared to the predicted outcomes in terms of production function theory. In most instances the results of this study were explicable but Howsen and Jarrel's theory had to be assumed to be valid in order to explain the positive sign on the population density variable, which was evident in the total crime model and the violent crime model.

6.3 RECOMMENDATIONS

Empirical analyses of total crime, property crime and violent crime in South Africa provide information on the most important determinants of each type of crime. This is important for public policy concentration, although it is acknowledged that a distinction must be made between those variables that are significant in explaining crime and those that are effective in preventing crime. Given that all categories of variables significantly influence the total and property crime rate, it must be concluded that the narrow focus on improving the effectiveness of the criminal justice system in order to deter crime is misguided. The elasticity estimates, which specifically consider the relative ability of explanatory variables to prevent crime, verify this conclusion. Total and property crimes appear to respond most to changes in the economic variables relating to education and then to changes in the law enforcement variable and socio-economic variable considered. It is, however, likely that the socio-economic variable and the other economic variables have a greater effect on the crime rate than the law enforcement variable as their elasticities are probably underestimated and the elasticity of the probability of prosecution is probably overestimated because unobserved heterogeneity was not taken into account. For violent crimes the only significant variable category appears to be law enforcement, however, this result is not conclusive.

Considering that the other types of public expenditure which are able to significantly reduce crime concern improvements in education and the well-being in female headed households, the reduction of poverty and possibly unemployment, it is evident that a

social-problems approach to crime is appropriate as South African crime appears to be predominantly 'poverty-induced'. Also considering that the crime reduction ability of increases in the probability of prosecution is more than likely overestimated, the central hypothesis in this study is verified. More public expenditure exclusively on the criminal justice system is not the most effective crime prevention policy for South Africa, other types of public expenditure that relate to the significant economic and socio-economic variables influencing crime must also be used to make crime prevention more effective.

It is recommended that the current practice of decreasing the return from illegitimate activities via criminal justice system deterrence expenditure is balanced with other types of public expenditure, which predominantly increase the return from legitimate activities as these have been shown to be valuable components of a crime prevention package in South Africa. The activities of other government agencies must be considered in terms of their effectiveness in crime prevention if the government is to substantially reduce crime. Cost implications, not dealt with in this study, must also be considered to determine the cost-effectiveness of the various crime prevention policy alternatives. In the long-term it may be possible to reduce expenditure on the criminal justice system once other crime prevention strategies have had an impact on the crime rate, however, in the short-term this expenditure should be maintained given the high level of crime in South Africa. This shift towards alternative crime prevention policies will only be possible within the framework of an interdisciplinary theory of crime and therefore it is recommended that this theoretical approach is adopted.

In Chapter Five analyses of South African policing production functions provide information on the resource inputs which are able to increase law enforcement output relating to crimes of different categories. As the log-linear functional form was adopted in the estimation of the models, the estimated coefficients are elasticity estimates. Considering these it is evident that policing effectiveness regarding total crime and property crime appears to be improved most by increases in expenditure on the vehicle fleet and then by increased employment of experienced officers. Effectiveness in violent crime policing appears to be improved most by the use of experienced officers and also by increases in the number of vehicles. For all crime types the number of police officers

employed and expenditure on computers display negative marginal productivity. It appears that this is associated with operational changes relating to post-apartheid transformation. Overall negative returns to scale are observed for policing in South Africa, irrespective of the crime category considered.

In order to calculate the crime reduction effect of increases in effective policing inputs, for each category of crime the elasticity of the probability of prosecution with respect to each policing input was multiplied by the elasticity of the crime rate with respect to the probability of prosecution. Although the numerical values calculated changed appropriately, the conclusions regarding the relative importance of policing inputs remained the same when their ability to effectively reduce South African crime rates was considered. It must, therefore be concluded that the secondary hypothesis in this study is verified in respect of policing, more expenditure on personnel is most certainly not effective in preventing crime, in fact it appears to detract from crime prevention.

It is recommended that the South African Police Service re-evaluates current resource allocation policy, specifically focussing on the implications for different crime categories. More specifically, vehicle capacity should be increased firstly and then the expertise of employees. Except in the case of violent crimes, for which the order of importance is reversed. The emphasis should be shifted away from increases in personnel. Although the cost implications of increasing these inputs were not considered in this study, it is clear that the cost-effectiveness of the proposed changes in inputs must be determined.

6.4 AREAS FOR FURTHER RESEARCH

More powerful explanatory models of crime causation will require further theorising and research employing additional sources of data and additional variables as well as changes to the model specification. Suggestions will be made regarding each of these.

Physiological and psychological theories of crime have been excluded from this study as they generally relate to personal characteristics which must be determined in an individual level study. However, these theories should be considered as some aspects

may be applicable to aggregate level variables and provide a greater insight regarding crime causation.

The absence of data imposed severe limitations on the empirical analysis of the crime rate in this study. The lack of criminal justice system data was the most restricting. Statistics collected throughout the entire system need to be revised and coordinated in order to provide relevant information for crime research. This study of the South African market for crime was confined to a single year, 1994, owing to the inadequacy of information relating to the Department of Justice and to a limited number of predominantly urban magisterial districts, owing to the collection format of Correctional Services data. Information required for this analysis which was not available or not available in a compatible format from the criminal justice system included: police presence, the presence of known criminals, the presence of gangs, data on arrests, prosecutions related to specific crimes, convictions related to specific crimes, sentencing related to specific crimes and gender and race related information for specific crimes or crime categories.

There are other data restrictions which also influenced the outcome of this analysis. No aggregate data at magisterial district level could be obtained regarding the presence of government employees, political leaders, business leaders, or any other powerful group in society. In South Africa national victimization studies are not common and therefore no information on actual crime figures, as opposed to the reported figures, is available. The 1994 October Household Survey data is not fully representative of the population at magisterial district level. Generally it does not include a large enough sample of the Black population and as a consequence, comparative statistics relating to this group specifically could not be used in this study.

The model specification adopted in this analysis of the market for crime in South Africa was restricted and for further research it is desirable to include a time-series perspective. LaFree et al. (1992:158) note that 'there is no guarantee that conclusions based on cross-sectional data will be supported when examined longitudinally'. Although it is obviously expected that certain longitudinal changes will be manifest in response to

changes in significant explanatory variables, this must be checked. The interdisciplinary theory of crime can then be tested to see whether it is able to explain, not only the fluctuations in the crime rate over time, but also the trend of the crime rate over time. Ideally pooled data should be used, it will then be possible to account for unobserved heterogeneity which appears to be statistically important in determining estimation coefficients.

In the case of the violent crime rate model, the assumption of the rationality of the criminal and the use of the economic model appear to be inappropriate. Other approaches to modelling violent crime must be considered in future research in order to gain an understanding of the causes of this type of crime in South Africa and the types of public policy which should be used to prevent it. Specific attention needs to be paid to the particular relationship between the unemployment rate and the crime rate within all South African models of crime. In most instances in this study the unemployment rate variables could not be considered but '[i]nternational studies ... indicate that crime tends to be closely correlated with unemployment' (South Africa Foundation 1996:34).

More powerful explanatory models of appropriate crime prevention policy will require a broader theoretical approach and additional information regarding the relevant costs and benefits to be included in the extended model. In the present study the effectiveness of various government agencies in providing a reduction in the crime rate per 100 000 of the population was evaluated. The efficiency of these government agencies has not been considered in this analysis and is taken as given. The cost-effectiveness of these agencies in preventing crime was not determined as the relative costs of employing the different agencies were not assessed in this study. Therefore this study concerns the effectiveness of various crime prevention alternatives and not their cost-effectiveness. This should be considered in further studies.

As this study only considered broad categories of crime, any shifts from one crime to another within these broad categories cannot be detected. Further research regarding the effectiveness of public expenditure on crime prevention in South Africa, needs to

address the issue of proportional budget allocations for the prevention of specific crimes based on prevention priorities. As crime prevention is costly, not all crime should be pursued. The level of efficiency of all government agencies should also be considered if the most appropriate crime prevention strategies are to be implemented regarding each crime. The efficiency of public expenditure on crime prevention is also of interest for further research. The optimal amount of expenditure on crime prevention in South Africa should be established and if an increase is necessary, the funds should be sourced.

More powerful explanatory models of appropriate criminal justice system resource allocation policy will require research employing additional variables as well as changes to the model specification.

Severe limitations were imposed on the empirical analysis of crime-related production functions, owing to the absence of data. It must be re-emphasized that throughout the system, and particularly within the Department of Justice, statistics and the format in which they are collected need to be revised. The South African Police Service also needs to make its data regarding the year 2000 available. This analysis was confined to the provincial level and to the department of Safety and Security, as the information provided by the Justice Department and the Department of Correctional Services was inadequate for inclusion. Information was only provided regarding one operational statistic that could be used as a proxy for each variable in the policing production functions. Therefore the proxy variables used in this analysis are not the best ones which were selected from a number of possible variables. Further, none of the input variables were appropriately defined in terms of crime category. It should also be noted that the crime information provided only relates to the twenty crimes prioritized nationally.

In this study the Cobb-Douglas production function itself was estimated. Intriligator et al. note that this method 'typically leads to econometric problems of simultaneity (endogenous explanatory variable), multicollinearity, and heteroskedasticity' (1996:289-290). Although all of these problems were noted in this study, the use of this method is

justifiable as there is little evidence to suggest that alternative estimation methods are better (Intriligator et al. 1996:290). Using this method, the effectiveness of various resource inputs in determining law enforcement output was evaluated. The cost-effectiveness of proposed changes in input was not determined in this study as the relative costs of employing the different inputs were not assessed. The cost-effectiveness of policy alternatives should be determined in future studies, however, this implies the use of other production function model specifications which are able to capture cost information. The cost-effectiveness of various resource allocation alternatives regarding different crimes and operational units is of interest for further research.

The concluding sentiments of Chiricos and Delone are applicable to this study. 'Our suggested areas of research are not simply a "wish list" for future research. They describe, in part, the current limits of "empirical plausibility" in our efforts to explain' (Chiricos & Delone 1992:433).

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APPENDIX A**THE SOCIOLOGICAL STRUCTURE AND RADICAL CRIMINOLOGY
THEORIES OF CRIME**

It should be noted that this discussion of the non-economic theories included within this interdisciplinary theory of crime causation is based principally on the work of Reid (1988) and Roshier (1989), although additional insights of other writers have been included.

The ecological or community theories of deviance originate from the work of Burgess and Park, who considered the social problems in Chicago in the 1920s and 1930s. Of particular interest to them was an area that they demarcated as zone 2. This area was changing from a residential to an industrial one as the central business district expanded. Housing in the area had deteriorated and it was inhabited by low income people. They believed that the deterioration of the physical environment had caused social changes which led to the social problems and deviance in zone 2. Shaw and M^cKay (Curran & Renzetti 1994:138) and subsequent researchers focussed exclusively on determining the causes of crime in zone 2. Essentially crime was seen as a function of the physical status of the environment, economic status and social values. Deviant social values were considered to be the most important determinant of crime as they embody the reaction of the community to living in the area.

In order to test these theories the degree of industrialisation must be determined and it should be positively related to crime. Variables like the degree of homelessness, the deterioration of housing and infant mortality should be considered in order to establish the physical status of an area. In terms of the theory, as the physical status decreases, social morals change and the moral cost of crime decreases, increasing the rate of crime. This is especially so if as the ecological theorists believed, in terms of the acquired social values in the community, prestige is gained as a result of criminal activity. In which case a social benefit is attached to crime. LaFree et al. (1992:157) state that family instability is important to consider in this regard. Strong family ties socialise people, particularly children, against criminal activity. Family instability,

however, lowers the moral cost of crime. Hawkins (1993:90) and LaFree et al. (1992:157) emphasise that this is also a theory about access to conventional opportunities that can be tested by examining whether there is a negative relationship between the crime rate and socio-economic status. LaFree et al. specifically mention employment, income and education as indicators of socio-economic status.

There are two anomie theories of crime; the first is associated with Durkheim and considers crime at an aggregate level and the second is associated with Merton and considers criminal activity at an individual level. Durkheim, who wrote at the end of the nineteenth century, believed that crime resulted from anomie, a state of normlessness which accompanies industrialisation. As societies developed and became more densely populated, owing to industrialisation, they became more complex with division of labour and specialisation as integral features. Inevitably the development of norms to accompany the new social structure lags behind the rapid industrial development. This results in anomie as aspirations therefore increase faster than the means to acquire them. Shelley's modernisation hypothesis is an extension of Durkheim's theory. She emphasises the youth and the fact that when they move to urban centres, social control over them weakens.

In order to test this theory the rate of industrialisation must be determined. The rate of industrialisation should be positively related to the level of crime, owing to the fact that industrialisation creates social disorganisation which lowers the moral cost of crime. Population density should also be positively related to the crime rate because the increased population density that accompanies industrialisation also lowers the moral cost of committing crime. As mentioned above, increases in population density also increase the return from criminal activity and therefore crime itself because they decrease the direct cost of crime and the probability of punishment. The proportion of youth in the population should also be determined as it is believed that the moral cost of crime is lower for youth experiencing anomie. Therefore they are more likely to participate in criminal activity causing the level of crime to increase. An important implication of Durkheim's theory is that the rapid increase in technology increases productivity but marginalises the less skilled individuals in society. The increase in

productivity would be reflected by an increase in median income. This would cause an increase in crime because the increased income represents an increase in the potential benefit from criminal activity. The marginalisation of unskilled workers can easily be revealed by considering whether the variables that comprise the general indicator of access to conventional opportunities display inequalities.

Merton's theory, published in 1938, was concerned with anomie which causes individuals to participate in criminal activity. In any society there are cultural goals and institutionalised means of achieving them, they comprise the social structure. Merton believed that the means of achieving goals were not equally available to all in society, which caused strain, or anomie, as the existing social structure exerted pressure on individuals that did not have the means. He considered five modes of adaptation to anomie associated with individuals. Three of them ultimately result in deviant behaviour, in order of importance they are: innovation, retreatism and rebellion. In the case of innovation, which he regarded as the cause of most crime, individuals accept the goals of society but reject the means of achieving them. Therefore according to Merton, the majority of crime was the direct result of the restricted conventional opportunities of the lower class for success and status.

LaFree et al. (1992:157) emphasized that employment, income, education and family stability are important variables in testing for crime caused by innovation. It is also important to note that Merton specifically considered individuals belonging to minority groups. Except for family stability, the above-mentioned variables are all general indicators of access to conventional opportunities. All the variables that are general indicators of access to conventional opportunities must be considered as important, including those not specifically mentioned. As restricted access to opportunities lowers the earnings from legitimate activities and therefore raises crime, socio-economic status and crime should be negatively related. Family instability should be positively related to crime as it lowers the moral cost of committing crime.

The anomie theories were followed by the subculture theories. However, the focus of the subculture theories was on the criminal activity of disadvantaged groups. These groups

within society are denied access to middle class systems of status and success and therefore create their own criteria for status and success. This was believed to entail the adoption of deviant values and norms. Essentially crime was seen as a means of achieving goals quicker or as a requirement in terms of the subculture. It was proposed that often status and prestige is achieved by participation in criminal activity. Commonly it was presumed that most subcultures were manifest in the establishment of gangs. Group autonomy, relating to the group identity and control, was believed to reinforce the deviant morals adopted.

Accordingly in order to test all of the subculture theories, all of the variables, except for gender, that are considered to be important indicators of restricted access to conventional opportunities, or alternatively low socio-economic status, must be regarded. Predictably the more restricted the access to opportunities, the lower the potential earnings from legitimate activities and the higher the rate of crime. Concerning gender, the emphasis is on males. In terms of the subculture theories, the moral cost of committing crime is lowered as a result of the presence of young people, males and deviant subcultures. All of these variables should be positively related to the crime rate as they lower the moral cost of crime and make individuals less averse to crime, effectively increasing the net earnings from illegitimate activities. It is important to note that the status and prestige acquired within subcultures by participating in crime may predispose group members towards crime to such an extent that they therefore perceive the moral cost of crime as being negative. That is, they attach an intrinsic benefit to criminal activities as opposed to a moral cost.

Although the essence of subculture theories have been explained, it is worthwhile to consider some of the different subculture theories in order to gain some insight into the specific aspects that are regarded as important in each. Thrasher, who considered gang formation among lower class boys in zone 2 in Chicago, believed that the group compensated for inadequate familial and educational socialisation. In terms of his theory family instability and lack of educational achievement, as indicators of access to conventional opportunities, must be significant determinants of delinquency.

Cohen also considered the delinquency of lower class boys, who experienced status frustration as they could not achieve middle class goals. He emphasized the lack of status acquired within the school system, both as a result of the low social status of the boys and that of their parents. According to him the important characteristics of the delinquent subculture could be identified as: nonutilitarianism, maliciousness, negativism, short run hedonism and group autonomy. Nonutilitarianism relates to the fact that the chief aim of activities was not material gain, but "for the hell of it". The term is a misnomer in economic terminology as members of the group derived utility from their activities, although it was not material. As their activities were malicious, they involved only petty crimes. Negativism refers to their rejection of middle class norms and their acceptance of polar opposite norms, that is middle class norms are inverted. This predisposed them towards criminal activity as they adopted a preference for crime. Short run hedonism refers to their focus on immediate gratification from the excitement of illegal activities. This implies that only the short run costs of crime, the direct and opportunity costs, were considered. In terms of this subculture negativism, short run hedonism and group autonomy all negatively influence the moral cost of crime and cause crime to increase. Negativism implies that within the subculture the moral cost is negative, or alternatively a benefit is attached to committing crime. Short run hedonism implies that generally accepted social morals are not considered at all. Group autonomy reinforces the deviant morals of the subculture. In terms of this theory, a large incidence of petty crimes must be established. The indicators of access to conventional opportunities must be considered and a low educational achievement and median income must be significant determinants of delinquency. This would indicate the lack of social status of youths and their parents.

Miller also considered the delinquent gang activities of lower class boys. He believed that all poverty caused a criminal culture. This criminal culture was a lower class culture, embodying unique lower class values that were not a reaction to or related to middle class values. He saw the important characteristics of the criminal culture as being: a preoccupation with trouble, toughness in a physical sense, (street) smartness, excitement as a result of risk-taking, fate and autonomy, within a highly restrictive environment. Essentially all of the characteristics of the criminal subculture negatively

influence the moral cost of committing crime and foster crime. Median income and income inequality, which are indicators of access to conventional opportunities, are important causal variables in terms of Miller's theory. The greater the extent of poverty and income inequality, the lower the potential earnings from legitimate activities and the greater the crime rate. Miller also emphasized the importance of the number of female-headed households. It should, however, be noted that in terms of this study the number of female-headed households is one possible proxy for the variable family instability. According to Miller the impact of female-headed households on crime is related to the socialisation of boys within these households. For boys in female-headed households a consistent adult male role model is absent and their first opportunity to learn about essential aspects of the male role is within a gang. In terms of this theory the greater the number of female-headed households, the greater the number of potential gang members and the lower the moral cost of crime and therefore the higher the rate of crime.

Wolfgang and Ferracuti considered an adult subculture of violent crime. Within this violent subculture a low value is placed on life and there is a willingness to participate in, expect and retaliate in terms of violence. This subculture was believed to be unrelated to gang activity, instead it was thought to be a set of attitudes which sanctioned the use of violence. The subculture was considered to be reinforced by the behaviour of the lower class and passed on generationally. In their research Wolfgang and Ferracuti were specifically concerned with homicide that was not premeditated or committed by individuals with mental disorders. In order to verify their theory the presence of a high rate of violent crime, especially murder, and poverty must be established and must be evident over a time period spanning generations.

There are two opportunity theories of crime that merit attention, differential opportunity theory and emancipation theory. Cloward and Ohlin also considered the gang activities of lower class boys. They developed a theory known as differential opportunity theory, which was a synthesis of Merton's anomie theory and Sutherland's differential association theory. Essentially Cloward and Ohlin stressed the inaccessibility of the lower class to conventional opportunities for success and status. They, however,

believed that innovation is a collective response of the lower class to this, not merely an individual mode of adaptation as Merton contended. Therefore the lower class would accept the cultural goals of society but reject the institutionalised means of acquiring them. Whether or not they adopted delinquent means would depend on their access to illegitimate opportunities. Sutherland's differential association theory is a sociological process theory which explains how criminal behaviour is learned. According to Sutherland, access to criminal opportunities is gained as a result of intimate personal contact with criminals. In terms of differential opportunity theory, differential access to both illegitimate opportunities, via criminal associations, and conventional opportunities was considered. Cloward and Ohlin identified three delinquent subcultures: the criminal subculture, the conflict subculture and the retreatist subculture. The criminal subculture results from the absence of conventional role models and opportunities and the presence of criminals, who are willing to have close contact with and assist the youth. The conflict subculture arises in communities that are socially disorganised and that restrict access to conventional and criminal opportunities. This isolation fosters gang formation, which relaxes the strain arising from exclusion from the community. These gangs are involved in violent crimes. The retreatist subculture is adopted by individuals that have failed within the criminal and conflict subcultures and resort to substance abuse.

All the variables that are considered to be important in testing the subculture theories are important in verifying differential opportunity theory. Their impact on crime should be the same. In order to test for specific subcultures, in addition the following variables must be considered. The presence of criminal associations must be determined when considering a criminal subculture. As mentioned above, criminal associations and crime are positively related as the returns from criminal activities are raised by criminal associations, owing to the lower direct and moral costs of crime and the more accurate estimation of the expected punishment cost of crime. In order to test for a conflict subculture, a high incidence of violent crimes must be established as well as the absence of criminal associations. In order to confirm the existence of a retreatist subculture a high incidence of substance related crimes must be established.

Simon and later Adler were particularly concerned with crime committed by women. They believed that the emancipation of women, which resulted in higher educational achievement and labour force participation, resulted in an increase in white collar crime committed by women. As a consequence of emancipation, women have the knowledge, responsibility and authority within business organisations that affords them the opportunities to commit crime. Essentially it was argued that for women, the earnings from business related illegitimate activities have increased as a result of increased access to the labour market. Gender, the unemployment rate and educational achievement are important variables that must be used in order to test these theories. The proportion of women that have achieved high levels of education and that participate in the labour force must be a *positive* and significant determinant of the rate of white collar crime in order to confirm this theory.

The Labelling theories of crime, which became popular in the 1960s, bridge the gap between the sociological structure and the radical criminology theories. Although these theorists focussed their attention on victimless crimes, an important contribution that they made was to stress that the definition of crime is variable or relative and depends on the society being considered. Essentially powerful groups and individuals in a society have the authority to define legislation and enforce it on others, whom they label as criminal. This they do by attaching punishment costs to the activities of the powerless groups, whether they be socially harmful or not. The socially harmful activities of the powerful groups are justified on grounds such as business practice. As mentioned above, this increases the rate of crime as no moral costs or expected punishment costs are incurred when the powerful groups undertake such activity. According to these theorists, power differentials result from differences in the social position of individuals.

In terms of the radical criminology theories of crime, the definition of crime was still considered to be variable but it was recognised that objectively crime could be defined as a violation of human rights. The earlier radical theorists followed the tradition of the labelling theorists by adhering to instrumental Marxism. That is, they believed that the legal system is an instrument of the ruling class and is used to maintain their position and privilege in society. The formulation and enforcement of law are for their benefit.

Bonger, who wrote at the turn of the century, stressed that although capitalism causes crime in all social classes, the attention of the legal system is focussed on the poor. The radical theorists were particularly concerned with the social, economic and political environment and how it influences individual circumstances; and the collective influence of the macro- and micro- environment on crime. Essentially they argued that capitalism, which accompanies industrialisation, results in inequalities in society which are manifest in the social class structure and are criminogenic. Bonger, who compared pre-capitalist and capitalist societies, contended that the emphasis of capitalism on self-interest and wealth accumulation alters the moral climate. That is, the change in the social structure resulting from capitalism lowers the moral cost of committing crime and therefore causes an increase in crime. Ultimately radical theorists believed that in order to reduce crime, the capitalist system must be replaced.

In order to test the radical criminology theories the extent of industrialisation must be considered. This variable should be a positive and significant determinant of crime. As in the case of Durkheim's anomie theory, the implication is that rapid increases in technology increase productivity but marginalise the less skilled individuals in society. This increases the potential earnings from illegitimate activities and decreases the earnings from legitimate activities respectively, ultimately causing crime to increase. Important variables to consider in this regard are the average level of income and the extent of inequalities displayed in the variables comprising the general indicator of access to conventional opportunities respectively. They should also be positive and significant in explaining crime. The variables comprising the general indicator of access to conventional opportunities are important to consider, not only because they indicate limited access of disadvantaged groups to opportunities for status and success, but also because they indicate the powerlessness of these groups in society. Additional variables can also be used to establish the existence of powerful groups that determine legislation and its enforcement. The types of crime that the legal system focuses on can be considered in order to establish whether the crimes of the powerful groups are underrepresented. It is also important to consider the characteristics of the individuals who are regarded as criminals by the legal system in order to ascertain whether the disadvantaged social groups are over represented. Quinney emphasized that the racial,

gender and class composition of personnel within the legal system resembles that of the powerful class. These are also important variables that can be used for testing radical theories.

The structural criminologists acknowledge that some laws override the interests of the powerful class and therefore reject instrumental Marxism, arguing that the legal system is used to resolve the inherent contradictions in capitalism in order to preserve capitalism in the long run. Although legislation is not determined by powerful groups, bias in law enforcement must still be considered and in this respect powerless groups remain the focus of the legal system. They emphasized that powerless groups are the victims of bias in law enforcement, not because of their low social status but because of their powerlessness. The social class structure in a capitalist society is an important factor to consider but it is as a result of inequality, and not poverty, that disadvantaged social classes face different opportunities, which result in crime. Therefore when regarding the variables comprising the general indicator of access to conventional opportunities in terms of their ability to explain crime, the extent of the inequalities displayed will be more significant than the levels of the variables. Hagen considered power relations in greater detail and distinguished two types of relations. Symbolic power relations relate to power used to influence law enforcement. This not only focuses the attention of the legal system on the powerless groups but very importantly, also diverts the attention of the system from the powerful groups. Instrumental power relations relate to power used to commit crimes. This is particularly important in the case of business related crimes, where power is gained with access to and within firms. If the variables used to ascertain access to business opportunities confirm this, effectively the earnings from business related illegitimate activities have been raised and crime encouraged.

Emancipation theory has been discussed above but three other feminist theories of crime are important to consider. They relate to gender relations in the family, the marginalisation of women and chivalry. Hagen extended his theory to gender relations in society. He contended that power relations in the family are derived from the relations in the work environment and distinguished between traditional patriarchal families and egalitarian families. In patriarchal families the mother stays at home to supervise the

children. The activities of daughters are more strictly controlled than those of sons and daughters are therefore less likely to be involved in risky activities like crime. In egalitarian families the mother participates in the labour force and the activities of daughters are no longer more strictly controlled than those of sons, therefore they are equally likely to be involved in crime. Essentially he argued that the emancipation of women results in their daughters committing crime. This can be understood by considering that for daughters in egalitarian families, the direct costs of committing crime and the probability of punishment are lower which raises the return from criminal activity and ultimately the crime rate. As this theory is an extension of emancipation theory, the variables that were considered important in verifying emancipation theory are important once more. But in order to specifically test this theory, the proportion of working mothers must be considered and it should be positively related to the criminal activity of young women.

Some theorists argue that since women are marginalised economically, they are more likely than males to be unemployed or to receive a lower wage for a given job. This marginalisation is intensified if women are young and belong to a minority group. It is essentially argued that, owing to gender discrimination in the labour market, for women the potential earnings from legitimate employment are lower and this results in an increase in crime committed by women, particularly petty property crime. In order to test the marginalisation theory, the variables which comprise the general indicator of access to conventional employment opportunities must be considered for women. That is, the unemployment rate and wage inequalities associated with women in general, and those that are young, and those that belong to a minority group must be considered. These variables should be positively related to petty property crime.

Other feminist theorists considered gender-related bias in law enforcement. The chivalry hypothesis contends that women are treated more leniently by the legal system. Therefore in terms of this hypothesis, the punishment costs of committing crime are lower for women than they are for men. This raises the return from criminal activity and ultimately causes crime. In order to test this theory possible gender bias in the punishment costs of crime must be considered. In order to verify this hypothesis, the

punishment costs for women should be lower than for men and should be negatively related to the crime committed by women.

APPENDIX B

**THE PEARSON PAIRWISE CORRELATION RESULTS FOR THE
TOTAL CRIME RATE**

Table B.1: Correlation between the Total Crime Rate and All Proxy Variables

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
Law Enforcement	Probability of Prosecution, given Crime / Probability of Prison Sentence, given Crime	negative	-0.2599 -0.1778	0.0134** 0.0936*
	Average Length of Prison Sentence / Expected Prison Sentence, given Crime	negative	-0.0430 -0.1677	0.6871 0.1141
	Average Household Income / Poverty-gap Index / Poverty-gap Index (calculated using expenditure)	negative	-0.0628 -0.1091 -0.1023	0.5568 0.3059 0.3374
Economic	Median Income / Standard Deviation in Income / Gini Coefficient	positive	0.1117 -0.0828 -0.0551	0.2947 0.4378 0.6059
	Unemployment Rate (expanded definition) / Unemployment Rate (narrow definition) / Male Unemployment Rate (expanded definition) / Male Unemployment Rate (narrow definition)	positive negative (business related)	-0.0791 -0.0550 -0.0480 -0.0368	0.4585 0.6067 0.6531 0.7308
	Average Number of Years of Education / Median Number of Years of Education / Proportion of Population with Primary Education / Proportion of Population with Secondary Education / Proportion of Population with Tertiary Education	negative positive (business related)	-0.2402 -0.2333 0.2123 -0.2082 -0.1478	0.0226** 0.0269** 0.0446** 0.0490** 0.1645
	Standard Deviation in Education Years	positive	-0.2808	0.0074***
	Average Age / Median Age	negative	-0.2101 -0.0708	0.0468** 0.5070
	Proportion of Population Younger than 15 Years / Proportion of Population Younger than 18 Years / Proportion of Population Younger than 25 Years / Proportion of Population between 16 and 25 Years / Proportion of Population between 18 and 25 Years	positive	0.1866 0.1363 0.0419 -0.1653 -0.1145	0.0782* 0.2001 0.6953 0.1196 0.2827
	Non-White/White Race Ratio / Black/Others Race Ratio / Black and Coloured/Others Race Ratio	positive	0.0432 -0.0270 0.0535	0.7075 0.8072 0.6353
	Black/Others Ratio of Median Income / Black and Coloured/Others Ratio of Median Income	positive	-0.0179 0.3037	0.9152 0.0425**

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance	
	Black/Others Ratio of Average Income /	negative	-0.0934	0.4287	
	Black/Others Ratio of Average Education Years /		-0.0431	0.7095	
	Black/Others Ratio of Median Education Years /		-0.0169	0.8845	
	Black/Others Ratio of Proportion with Primary Education /		-0.1443	0.2106	
	Black/Others Ratio of Proportion with Secondary Education /		-0.0423	0.7165	
	Black/Others Ratio of Proportion with Tertiary Education /		-0.0060	0.9614	
	Black and Coloured/Others Ratio of Average Income /		-0.0139	0.9058	
	Black and Coloured/Others Ratio of Average Education Years /		0.0278	0.8067	
	Black and Coloured/Others Ratio of Median Education Years /		positive (business related)	-0.0207	0.8551
	Black and Coloured/Others Ratio of Proportion with Primary Education /			-0.1437	0.2125
	Black and Coloured/Others Ratio of Proportion with Secondary Education /			-0.0301	0.7936
	Black and Coloured/Others Ratio of Proportion with Tertiary Education			0.0107	0.9307
	Black/Others Ratio of Unemployment Rate (expanded definition) /	positive		-0.0737	0.5445
	Black/Others Ratio of Unemployment Rate (narrow definition) /		-0.0270	0.8306	
	Black and Coloured/Others Ratio of Unemployment (expanded) /	negative (business related)	-0.0797	0.5628	
	Black and Coloured/Others Ratio of Unemployment (narrow)		-0.0856	0.5501	
	Female/Male Gender Ratio	negative	-0.1151	0.28	
	Female/Male Ratio of Median Income /	positive	-0.0087	0.9437	
	Female Median Income		0.0508	0.6343	
	Female/Male Ratio of Average Income /	negative	0.0178	0.8674	
	Female Average Income /		-0.0411	0.7002	
	Female/Male Ratio of Average Education Years /		0.0077	0.9423	
	Female/Male Ratio of Median Education Years /		-0.0073	0.9460	
	Female Average Education Years /		-0.2370	0.0245**	
	Female Median Education Years /		-0.2353	0.0256**	
	Female/Male Ratio of Proportion with Primary Education /		positive (business related)	-0.0517	0.6287
	Female/Male Ratio of Proportion with Secondary Education /			-0.1401	0.1880
Female/Male Ratio of Proportion with Tertiary Education /	0.1731			0.1456	
Female Proportion with Primary Education /	0.2078			0.0494**	
Female Proportion with Secondary Education /	-0.2067			0.0506*	
Female Proportion with Tertiary Education	-0.1275			0.2312	
Female/Male Ratio of Unemployment Rate (expanded definition) /	positive	-0.1316	0.2416		
Female/Male Ratio of Unemployment Rate (narrow definition) /		-0.1787	0.1359		
Female Unemployment Rate (expanded definition) /	negative (business related)	-0.1169	0.2726		
Female Unemployment Rate (narrow definition)		-0.0752	0.4812		
Socio - Economic	Proportion of Mothers that Work	positive	-0.0648	0.5441	
	Workers in Manufacturing as Proportion of the Economically Active /	positive	0.0826	0.4387	
	Workers in Service Industry as Proportion of the Economically Active		-0.0401	0.7077	

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
	Ratio of Agricultural Workers to Workers in Manufacturing / Ratio of Workers in Manufacturing to Service Industry Workers	negative	-0.0525 -0.2062	0.6639 0.0801*
	Proportion of Households in which there is Divorce / Proportion of Female Headed Households	positive	-0.1226 -0.1500	0.2495 0.1582
	Proportion of Households in which there is Marriage	negative	0.0104	0.9224
	Presence of Gang Activity	positive	-0.0935	0.3809
	Population per square kilometer Proportion of Population that Resides in Urban Area	positive	-0.0727 -0.2163	0.4958 0.0406**

* 90 percent level of confidence

** 95 percent level of confidence

*** 99 percent level of confidence

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APPENDIX C

**THE PEARSON PAIRWISE CORRELATION RESULTS FOR THE PROPERTY
CRIME AND VIOLENT CRIME RATES**

Table C.1: Correlation between the Property Crime Rate and All Proxy Variables

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
Law Enforcement	Probability of Prosecution, given Crime /	negative	-0.2379	0.0240**
	Probability of Prison Sentence, given Crime		-0.1641	0.1223
	Average Length of Prison Sentence / Expected Prison Sentence, given Crime	negative	-0.0111 -0.1541	0.9172 0.1469
Economic	Average Household Income /	negative	-0.0531	0.6189
	Poverty-gap Index /		-0.1109	0.2980
	Poverty-gap Index (calculated using expenditure)		-0.1071	0.3152
	Median Income /	positive	0.0983	0.3589
	Standard Deviation in Income /		-0.0705	0.5088
	Gini Coefficient		-0.0682	0.5231
	Unemployment Rate (expanded definition) /	positive	-0.0826	0.4389
	Unemployment Rate (narrow definition) /		-0.0623	0.5596
	Male Unemployment Rate (expanded definition) /	negative (business related)	-0.0452	0.6726
	Male Unemployment Rate (narrow definition)		-0.0351	0.7426
	Average Number of Years of Education /	negative	-0.2170	0.0400**
	Median Number of Years of Education /		-0.2079	0.0492**
	Proportion of Population with Primary Education /		0.1906	0.0719*
	Proportion of Population with Secondary Education /	positive (business related)	-0.1859	0.0794*
	Proportion of Population with Tertiary Education		-0.1360	0.2013
	Standard Deviation in Education Years	positive	-0.2711	0.0098***
	Average Age /	negative	-0.1815	0.0870*
	Median Age		-0.0491	0.6460
	Proportion of Population Younger than 15 Years /	positive	0.1594	0.1334
Proportion of Population Younger than 18 Years /	0.1115		0.2955	
Proportion of Population Younger than 25 Years /	0.0211		0.8439	
Proportion of Population between 16 and 25 Years /	-0.1607		0.1302	
Proportion of Population between 18 and 25 Years	-0.1143		0.2836	
Non-White/White Race Ratio /	positive		0.0344	0.7650
Black/Others Race Ratio /		-0.0297	0.7889	
Black and Coloured/Others Race Ratio		0.0287	0.8131	
Black/Others Ratio of Median Income /	positive	-0.0556	0.7402	
Black and Coloured/Others Ratio of Median Income		0.2649	0.0786*	

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance	
	Black/Others Ratio of Average Income /	negative	-0.0919	0.4360	
	Black/Others Ratio of Average Education Years /		-0.0521	0.6530	
	Black/Others Ratio of Median Education Years /		-0.0344	0.7679	
	Black/Others Ratio of Proportion with Primary Education /		-0.1368	0.2354	
	Black/Others Ratio of Proportion with Secondary Education /		-0.0299	0.7974	
	Black/Others Ratio of Proportion with Tertiary Education /		-0.0030	0.9806	
	Black and Coloured/Others Ratio of Average Income /		-0.0254	0.8291	
	Black and Coloured/Others Ratio of Average Education Years /		0.0388	0.7327	
	Black and Coloured/Others Ratio of Median Education Years /		positive (business related)	-0.0109	0.9235
	Black and Coloured/Others Ratio of Proportion with Primary Education /			-0.1527	0.1848
	Black and Coloured/Others Ratio of Proportion with Secondary Education /		0.0076	0.9472	
	Black and Coloured/Others Ratio of Proportion with Tertiary Education		0.0275	0.8226	
	Black/Others Ratio of Unemployment Rate (expanded definition)/	positive	-0.0649	0.5936	
	Black/Others Ratio of Unemployment Rate (narrow definition) /		-0.0138	0.9128	
	Black and Coloured/Others Ratio of Unemployment (expanded) /	negative (business related)	-0.0774	0.5745	
	Black and Coloured/Others Ratio of Unemployment (narrow)		-0.0793	0.5803	
	Female/Male Gender Ratio	negative	-0.1336	0.2095	
	Female/Male Ratio of Median Income /	positive	-0.0344	0.7791	
	Female Median Income		0.0217	0.8393	
	Female/Male Ratio of Average Income /	negative	0.0088	0.9495	
	Female Average Income /		-0.0393	0.7129	
	Female/Male Ratio of Average Education Years /		-0.0041	0.9690	
	Female/Male Ratio of Median Education Years /		-0.0153	0.8868	
	Female Average Education Years /		-0.2156	0.0413**	
	Female Median Education Years /		-0.2117	0.0452**	
	Female/Male Ratio of Proportion with Primary Education /		positive (business related)	-0.0389	0.7157
	Female/Male Ratio of Proportion with Secondary Education /			-0.1349	0.2048
	Female/Male Ratio of Proportion with Tertiary Education /			0.1441	0.2273
	Female Proportion with Primary Education /			0.1878	0.0763*
	Female Proportion with Secondary Education /		-0.1852	0.0805*	
	Female Proportion with Tertiary Education		-0.1213	0.2548	
	Female/Male Ratio of Unemployment Rate (expanded definition)/	positive	-0.1397	0.2134	
	Female/Male Ratio of Unemployment Rate (narrow definition) /		-0.1918	0.1090	
	Female Unemployment Rate (expanded definition) /	negative (business related)	-0.1230	0.2482	
	Female Unemployment Rate (narrow definition)		-0.0866	0.4173	
Socio - Economic	Proportion of Mothers that Work	positive	-0.0734	0.4918	
	Workers in Manufacturing as Proportion of the Economically Active /	positive	0.1210	0.2560	
	Workers in Service Industry as Proportion of the Economically Active		-0.0442	0.6792	

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
	Ratio of Agricultural Workers to Workers in Manufacturing / Ratio of Workers in Manufacturing to Service Industry Workers	negative	-0.0607 -0.1712	0.6148 0.1476
	Proportion of Households in which there is Divorce / Proportion of Female Headed Households	positive	-0.1210 -0.1455	0.2558 0.1712
	Proportion of Households in which there is Marriage	negative	0.0041	0.9695
	Presence of Gang Activity	positive	-0.0715	0.503
	Population per square kilometer / Proportion of Population that Resides in Urban Area	positive	-0.0485 -0.1918	0.6498 0.0701*

* 90 percent level of confidence

** 95 percent level of confidence

*** 99 percent level of confidence

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Table C.2: Correlation between the Violent Crime Rate and All Proxy Variables

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
Law Enforcement	Probability of Prosecution, given Crime /	negative	-0.2169	0.0400**
	Probability of Prison Sentence, given Crime		-0.1522	0.1520
	Average Length of Prison Sentence /	negative	-0.0137	0.8981
	Expected Prison Sentence, given Crime		-0.1429	0.1789
Economic	Average Household Income /	negative	-0.0608	0.5694
	Poverty-gap Index /		-0.1280	0.2294
	Poverty-gap index (calculated using expenditure)		-0.1218	0.2526
	Median Income /	positive	0.1022	0.3379
	Standard Deviation in Income /		-0.0754	0.4802
	Gini Coefficient		-0.0560	0.5999
	Unemployment Rate (expanded definition) /	positive	-0.1054	0.3228
	Unemployment Rate (narrow definition) /		-0.0761	0.4758
	Male Unemployment Rate (expanded definition) /	negative (business related)	-0.0631	0.5547
	Male Unemployment Rate (narrow definition)		-0.0480	0.6532
	Average Number of Years of Education /	negative	-0.1982	0.0611*
	Median Number of Years of Education /		-0.1867	0.0781*
	Proportion of Population with Primary Education /		0.1715	0.1060
	Proportion of Population with Secondary Education /	positive (business related)	-0.1664	0.1171
	Proportion of Population with Tertiary Education		-0.1251	0.2399
	Standard Deviation in Education Years	positive	-0.2656	0.0114**
	Average Age /	negative	-0.1792	0.0910*
	Median Age		-0.0338	0.7519
	Proportion of Population Younger than 15 Years /	positive	0.1456	0.1709
	Proportion of Population Younger than 18 Years /		0.1025	0.3364
	Proportion of Population Younger than 25 Years /		0.0096	0.9282
	Proportion of Population between 16 and 25 Years /		-0.1673	0.1150
Proportion of Population between 18 and 25 Years	-0.1298		0.2226	
Non-White/White Race Ratio /	positive		0.0075	0.9480
Black/Others Race Ratio /		-0.0461	0.6773	
Black and Coloured/Others Race Ratio		0.0046	0.9678	
Black/Others Ratio of Median Income /	positive	-0.0629	0.7075	
Black and Coloured/Others Ratio of Median Income		0.3336	0.0251**	

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance	
	Black/Others Ratio of Average Income /	negative	-0.0758	0.5207	
	Black/Others Ratio of Average Education Years /		-0.0541	0.6401	
	Black/Others Ratio of Median Education Years /		-0.0241	0.8365	
	Black/Others Ratio of Proportion with Primary Education /		-0.1287	0.2646	
	Black/Others Ratio of Proportion with Secondary Education /		-0.0215	0.8538	
	Black/Others Ratio of Proportion with Tertiary Education /		0.0695	0.5762	
	Black and Coloured/Others Ratio of Average Income /		-0.0346	0.7685	
	Black and Coloured/Others Ratio of Average Education Years /		0.0902	0.4280	
	Black and Coloured/Others Ratio of Median Education Years /		positive (business related)	0.0363	0.7492
	Black and Coloured/Others Ratio of Proportion with Primary Education /			-0.2138	0.0619*
	Black and Coloured/Others Ratio of Proportion with Secondary Education /			0.0673	0.5582
	Black and Coloured/Others Ratio of Proportion with Tertiary Education		0.0842	0.4913	
	Black/Others Ratio of Unemployment Rate (expanded definition) /	positive	-0.0600	0.6217	
	Black/Others Ratio of Unemployment Rate (narrow definition) /		-0.0107	0.9328	
	Black and Coloured/Others Ratio of Unemployment (expanded) /	negative (business related)	-0.0699	0.6119	
	Black and Coloured/Others Ratio of Unemployment (narrow)		-0.0857	0.5498	
	Female/Male Gender Ratio	negative	-0.139	0.1914	
	Female/Male Ratio of Median Income /	positive	-0.0380	0.7568	
	Female Median Income		0.0194	0.8559	
	Female/Male Ratio of Average Income /	negative	0.0129	0.9040	
	Female Average Income /		-0.0427	0.6893	
	Female/Male Ratio of Average Education Years /		-0.0197	0.8541	
	Female/Male Ratio of Median Education Years /		-0.0192	0.8584	
	Female Average Education Years /		-0.1981	0.0613*	
	Female Median Education Years /		-0.1903	0.0724*	
	Female/Male Ratio of Proportion with Primary Education /		positive (business related)	-0.0291	0.7858
	Female/Male Ratio of Proportion with Secondary Education /			-0.1461	0.1693
Female/Male Ratio of Proportion with Tertiary Education /	0.1495			0.2102	
Female Proportion with Primary Education /	0.1701			0.1089	
Female Proportion with Secondary Education /	-0.1674			0.1149	
Female Proportion with Tertiary Education	-0.1116			0.2950	
Female/Male Ratio of Unemployment Rate (expanded definition) /	positive	-0.1400	0.2124		
Female/Male Ratio of Unemployment Rate (narrow definition) /		-0.1940	0.1049		
Female Unemployment Rate (expanded definition) /	negative (business related)	-0.1483	0.1629		
Female Unemployment Rate (narrow definition)		-0.1012	0.3428		
Socio - Economic	Proportion of Mothers that Work	positive	-0.0731	0.4938	
	Workers in Manufacturing as Proportion of the Economically Active /	positive	0.1483	0.1631	
	Workers in Service Industry as Proportion of the Economically Active		-0.0393	0.7132	

Variable Type	Variable Name	Expected Sign	Correlation Coefficient	Level of Significance
	Ratio of Agricultural Workers to Workers in Manufacturing / Ratio of Workers in Manufacturing to Service Industry Workers	negative	-0.0747 -0.1717	0.5359 0.1464
	Proportion of Households in which there is Divorce / Proportion of Female Headed Households	positive	-0.1113 -0.1515	0.2961 0.1539
	Proportion of Households in which there is Marriage	negative	0.0103	0.9232
	Presence of Gang Activity	positive	-0.072	0.5
	Population per square kilometer Proportion of Population that Resides in Urban Area	positive	-0.0477 -0.1892	0.6555 0.0741*

*90 percent level of confidence

** 95 percent level of confidence

*** 99 percent level of confidence

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APPENDIX D

SUMMARY STATISTICS OF CRIME RATE MODEL VARIABLES

Table D.1: Descriptive Statistics of Dependant and Explanatory Variables in the Model

Variable	Number of Observations	Mean	Standard deviation	Minimum	Maximum
totalcr	90	6.944749	0.6769067	5.31296	8.939769
violcr	90	6.096273	0.8239452	3.826844	8.659747
propcr	90	6.716603	0.7577158	4.828596	9.021694
probcort	90	2.94238	3.622752	0.982863	20.65788
avetime	90	4.191202	2.023291	1.485283	8.919151
poor	90	0.1360314	0.0984133	0.0016181	0.4020781
gini	90	0.5414323	0.0898279	0.3442025	0.8798248
unex	90	20.08739	15.02091	0	69.04762
aveeduc	90	5.848285	1.759098	1.595588	9.75
sdeduc	90	4.168429	0.4850047	2.533856	5.034372
aveage	90	27.80839	2.808081	21.07076	37.00867
age15	90	0.318947	0.0577482	0.1416185	0.4693878
age16a25	90	0.146103	0.0340203	0.0505618	0.2971698
bcpop	90	2.06e+08	6.76e+08	0	4.23e+09
notwhpop	90	2.77e+08	7.77e+08	0	4.23e+09
bcaveinc	90	5.61e+12	5.28e+13	0	5.01e+14
bc7ed	90	1023328	2671577	0	9632353
bcunnr	90	5.33e+07	1.05e+08	0	5.00e+08
bcunex	90	8.01e+07	1.60e+08	0	6.90e+08
fempop	90	1.083034	0.1336542	0.755814	1.428571
faveinc	90	8711.817	23298.11	17.275	152480.8
faveeduc	90	5.843166	1.745131	1.463768	9.765625
funnr	90	9911690	2.89e+07	0	1.67e+08
momwork	90	0.3568449	0.1330475	0.0967742	0.7317073
medinc	90	171.7222	318.6689	0	1386
bcmedinc	90	3.34e+08	8.55e+08	0	3.20e+09
fmedinc	90	42.31667	166.1799	0	1364
fmmedinc	90	6111111	5.80e+07	0	5.50e+08
manuserv	90	5555557	2.64e+07	0	2.00e+08
femhh	90	0.2499827	0.1580172	0.0166667	0.8666667
urban	90	0.6131024	0.3711956	0	1
urban ²	90	0.5121497	0.3921164	0	1
totalcr1	90	203.8378	303.8369	11.93069	2542.674
violcr1	90	7247.469	11644.15	426.0962	99456.73
propcr1	90	4216.601	6334.932	267.5884	52287.29

APPENDIX E

HAUSMAN SPECIFICATION TESTS OF THE CRIME MODELS

The total crime model:

Step 1: Regressing the endogenous variable on all the exogenous variables in the equation system.

regress probcort avetime medinc gini poor unex aveeduc sdeduc aveage age15 bcpop bcaveinc bcmedinc bcunnr bc7ed fempop faveinc fmedinc faveeduc funnr momwork manuserv femhh urban urban2 totalcr1

Source	SS	df	MS	Number of obs = 90		
Model	379.746447	25	15.1898579	F(25, 64) = 1.23		
Residual	788.31912	64	12.3174863	Prob > F = 0.2474		
Total	1168.06557	89	13.1243322	R-squared = 0.3251		
				Adj R-squared = 0.0615		
				Root MSE = 3.5096		

probcort	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
avetime	.3081517	.2535311	1.215	0.229	-.1983348	.8146382
medinc	.0004056	.0019242	0.211	0.834	-.0034384	.0042496
gini	.0111479	4.963619	0.002	0.998	-9.904819	9.927115
poor	-4.758921	5.375364	-0.885	0.379	-15.49745	5.979603
unex	-.0488847	.0499691	-0.978	0.332	-.1487094	.0509399
aveeduc	.6955126	2.099633	0.331	0.742	-3.498987	4.890012
sdeduc	.8654691	1.515465	0.571	0.570	-2.162019	3.892958
aveage	.1096618	.277439	0.395	0.694	-.4445863	.66391
age15	-12.20277	15.9871	-0.763	0.448	-44.14066	19.73513
bcpop	1.77e-10	1.11e-09	0.160	0.874	-2.04e-09	2.39e-09
bcaveinc	4.07e-15	8.91e-15	0.457	0.649	-1.37e-14	2.19e-14
bcmedinc	4.35e-10	5.84e-10	0.744	0.459	-7.32e-10	1.60e-09
bcunnr	-1.59e-09	5.90e-09	-0.269	0.789	-1.34e-08	1.02e-08

bc7ed	6.05e-08	3.12e-07	0.194	0.847	-5.63e-07	6.84e-07
fempop	1.173455	4.380637	0.268	0.790	-7.577873	9.924784
faveinc	.0000247	.0000175	1.414	0.162	-.0000102	.0000596
fmedinc	.0000346	.0029872	0.012	0.991	-.005933	.0060022
faveeduc	-1.065315	2.010572	-0.530	0.598	-5.081894	2.951263
funnr	-6.94e-09	1.59e-08	-0.437	0.664	-3.87e-08	2.48e-08
momwork	1.329354	4.94801	0.269	0.789	-8.555433	11.21414
manuserv	1.37e-09	2.29e-08	0.060	0.952	-4.43e-08	4.71e-08
femhh	6.09574	4.158522	1.466	0.148	-2.211862	14.40334
urban	-.4070538	5.45399	-0.075	0.941	-11.30265	10.48854
urban2	1.065414	4.758093	0.224	0.824	-8.43997	10.5708
totalcr1	-.0028644	.0019878	-1.441	0.154	-.0068355	.0011068
_cons	-7.220141	14.83187	-0.049	0.961	-30.35208	28.90805

predict yhat

predict e, resid

rename yhat hausyp8

rename e hausep8

Step 2: Estimating the crime rate equation, using the predicted values of the endogenous variable and the residuals, as an additional variable.

```
regress totalcr hausyp8 hausep8 avetime medinc gini poor unex aveeduc sdeduc
aveage age15 bcpop bcaveinc bcmedinc bcunnr bc7ed fempop faveinc fmedinc
faveeduc funnr momwork manuserv femhh urban urban2
```

Source	SS	df	MS	Number of obs = 90
Model	34.1696682	26	1.31421801	F(26, 63) = 12.53
Residual	6.61037392	63	.10492657	Prob > F = 0.0000
				R-squared = 0.8379
				Adj R-squared = 0.7710
Total	40.7800421	89	.45820272	Root MSE = .32392

totalcr	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
---------	-------	-----------	---	------	----------------------

hausyp8	-.6832578	.0640515	-10.667	0.000	-.8112544	-.5552612
hausep8	-.0938182	.011537	-8.132	0.000	-.116873	-.0707634
avetime	.2097335	.0283769	7.391	0.000	.1530268	.2664401
medinc	.0004414	.0001727	2.556	0.013	.0000964	.0007865
gini	.54127	.4580033	1.182	0.242	-.3739766	1.456517
poor	-2.43713	.5529885	-4.407	0.000	-3.542189	-1.332071
unex	-.0257757	.0057525	-4.481	0.000	-.0372712	-.0142802
aveeduc	.6508699	.2028767	3.208	0.002	.2454532	1.056287
sdeduc	.7106444	.1537917	4.621	0.000	.4033162	1.017973
aveage	.0567004	.0263161	2.155	0.035	.0041118	.1092889
age15	-6.400625	1.704253	-3.756	0.000	-9.806302	-2.994947
bcpop	2.22e-10	1.05e-10	2.116	0.038	1.24e-11	4.33e-10
bcaveinc	3.95e-15	8.69e-16	4.548	0.000	2.21e-15	5.69e-15
bcmedinc	1.99e-10	5.86e-11	3.387	0.001	8.14e-11	3.16e-10
bcunnr	-1.44e-09	5.48e-10	-2.628	0.011	-2.53e-09	-3.45e-10
bc7ed	6.68e-08	2.79e-08	2.396	0.020	1.11e-08	1.23e-07
fempop	1.38103	.4017773	3.437	0.001	.5781422	2.183918
faveinc	.0000185	2.20e-06	8.399	0.000	.0000141	.0000228
fmedinc	-.0002766	.0002757	-1.003	0.319	-.0008275	.0002743
faveeduc	-.7597018	.2025747	-3.750	0.000	-1.164515	-.3548885
funnr	-5.43e-09	1.49e-09	-3.640	0.001	-8.42e-09	-2.45e-09
momwork	1.432943	.4847455	2.956	0.004	.4642565	2.401629
manuserv	-8.65e-09	2.06e-09	-4.197	0.000	-1.28e-08	-4.53e-09
femhh	3.881757	.6290833	6.170	0.000	2.624635	5.13888
urban	-2.179141	.505894	-4.308	0.000	-3.19009	-1.168193
urban2	1.770142	.4469712	3.960	0.000	.8769413	2.663343
_cons	3.97036	1.369021	2.900	0.005	1.23459	6.706129

Conclusion: Simultaneity cannot be rejected as the error term is significant (99% level of confidence).

The property crime model:Step 1:

regress probcort avetime medinc gini poor unex aveeduc sdeduc aveage age16a25
 notwhpop bcaveinc bcmedinc bcunex bc7ed fempop faveinc fmmedinc faveeduc funnr
 momwork manuserv femhh urban urban2 propr1

Source	SS	df	MS	Number of obs = 90
Model	402.234974	25	16.089399	F(25, 64) = 1.34
Residual	765.830593	64	11.966103	Prob > F = 0.1713
Total	1168.06557	89	13.1243322	R-squared = 0.3444
				Adj R-squared = 0.0883
				Root MSE = 3.4592

probcort	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
avetime	.4009455	.2502912	1.602	0.114	-.0990687	.9009596
medinc	-.0002242	.0018805	-0.119	0.905	-.0039809	.0035326
gini	-2.778503	4.921358	-0.565	0.574	-12.61005	7.05304
poor	-3.344006	5.288118	-0.632	0.529	-13.90824	7.220224
unex	-.0499142	.0538219	-0.927	0.357	-.1574359	.0576075
aveeduc	.7324963	2.010604	0.364	0.717	-3.284147	4.749139
sdeduc	.8784823	1.477991	0.594	0.554	-2.074145	3.831109
aveage	.1797297	.2070644	0.868	0.389	-.2339291	.5933884
age16a25	-7.782554	15.70132	-0.496	0.622	-39.14955	23.58444
notwhpop	-5.34e-11	7.82e-10	-0.068	0.946	-1.62e-09	1.51e-09
bcaveinc	4.66e-15	7.95e-15	0.586	0.560	-1.12e-14	2.05e-14
bcmedinc	3.88e-10	5.74e-10	0.676	0.502	-7.59e-10	1.53e-09
bcunex	1.35e-09	3.92e-09	0.344	0.732	-6.49e-09	9.19e-09
bc7ed	1.92e-07	2.74e-07	0.700	0.486	-3.55e-07	7.39e-07
fempop	1.167491	4.312327	0.271	0.787	-7.447372	9.782354
faveinc	.0000266	.0000175	1.525	0.132	-8.25e-06	.0000615
fmmedinc	-1.20e-08	7.73e-09	-1.557	0.124	-2.75e-08	3.41e-09
faveeduc	-.6409245	1.989975	-0.322	0.748	-4.616356	3.334507

funnr	-9.18e-09	1.58e-08	-0.580	0.564	-4.08e-08	2.25e-08
momwork	2.99728	4.611534	0.650	0.518	-6.215318	12.20988
manuserv	-3.70e-09	2.21e-08	-0.167	0.868	-4.79e-08	4.05e-08
femhh	6.850866	3.876799	1.767	0.082	-.8939293	14.59566
urban	-1.66331	5.492351	-0.303	0.763	-12.63554	9.308923
urban2	1.224851	4.617758	0.265	0.792	-8.000182	10.44988
propcr1	-.0001153	.0000946	-1.219	0.227	-.0003042	.0000737
_cons	-7.459344	9.279087	-0.804	0.424	-25.99645	11.07776

predict yhat

predict e, resid

rename yhat hausyp9

rename e hausep9

Step2:

regress propcr hausyp9 hausep9 avetime medinc gini poor unex aveeduc sdeduc
aveage age16a25 notwhpop bcaveinc bcmedinc bcunex bc7ed fempop faveinc
fmmedinc faveeduc funnr momwork manuserv femhh urban urban2

Source	SS	df	MS	Number of obs = 90
Model	43.4197508	26	1.66999042	F(26, 63) = 13.70
Residual	7.6781015	63	.121874627	Prob > F = 0.0000
Total	51.0978523	89	.574133172	R-squared = 0.8497
				Adj R-squared = 0.7877
				Root MSE = .34911

propcr	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
hausyp9	-.8732212	.0828142	-10.544	0.000	-1.038712 - .7077301
hausep9	-.1028392	.0126151	-8.152	0.000	-.1280484 - .0776299
avetime	.3455443	.0403108	8.572	0.000	.2649896 .4260991
medinc	-.0001194	.0001959	-0.609	0.545	-.0005109 .0002721
gini	-1.316151	.5797597	-2.270	0.027	-2.474708 - .1575937
poor	-2.434606	.5984785	-4.068	0.000	-3.630569 - 1.238642

unex	-.0395223	.0074858	-5.280	0.000	-.0544815	-.0245631
aveeduc	1.12447	.2187591	5.140	0.000	.6873148	1.561625
sdeduc	.8368252	.1677432	4.989	0.000	.5016171	1.172033
aveage	.1271866	.0260815	4.877	0.000	.0750669	.1793062
age16a25	-5.252979	1.557182	-3.373	0.001	-8.364759	-2.141199
notwhpop	1.43e-10	7.88e-11	1.812	0.075	-1.46e-11	3.00e-10
bcaveinc	5.14e-15	9.22e-16	5.578	0.000	3.30e-15	6.98e-15
bcmedinc	2.25e-10	6.45e-11	3.480	0.001	9.56e-11	3.53e-10
bcunex	1.30e-09	4.31e-10	3.029	0.004	4.44e-10	2.17e-09
bc7ed	1.65e-07	2.87e-08	5.757	0.000	1.08e-07	2.23e-07
fempop	1.564322	.4307896	3.631	0.001	.7034575	2.425186
faveinc	.0000249	2.76e-06	9.008	0.000	.0000193	.0000304
fmmedinc	-8.33e-09	1.38e-09	-6.015	0.000	-1.11e-08	-5.56e-09
faveeduc	-.9151797	.213192	-4.293	0.000	-1.34121	-.4891495
funnr	-7.98e-09	1.67e-09	-4.775	0.000	-1.13e-08	-4.64e-09
momwork	2.560822	.5674665	4.513	0.000	1.42683	3.694813
manuserv	-1.23e-08	2.42e-09	-5.093	0.000	-1.72e-08	-7.50e-09
femhh	5.094735	.7669719	6.643	0.000	3.562064	6.627406
urban	-3.26417	.5643981	-5.783	0.000	-4.39203	-2.136311
urban2	2.207829	.473631	4.661	0.000	1.261353	3.154305
_cons	-1.236745	1.152644	-1.073	0.287	-3.54012	1.06663

Conclusion: Simultaneity cannot be rejected as the error term is significant (99% level of confidence).

The violent crime model:

Step1:

regress probcort avetime medinc gini poor unex aveeduc sdeduc aveage age16a25 notwhpop bcaveinc bcmedinc bcunnr bc7ed fempop faveinc fmmedinc faveeduc funnr momwork manuserv femhh urban urban2 violcr1

Source	SS	df	MS	Number of obs = 90
Model	398.995417	25	15.9598167	F(25, 64) = 1.33
Residual	769.07015	64	12.0167211	Prob > F = 0.1811
Total	1168.06557	89	13.1243322	R-squared = 0.3416
				Adj R-squared = 0.0844
				Root MSE = 3.4665

probcort	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
avetime	.4152356	.2509614	1.655	0.103	-.0861173	.9165886
medinc	-.0000752	.0018123	-0.041	0.967	-.0036957	.0035454
gini	-2.759509	4.934214	-0.559	0.578	-12.61673	7.097715
poor	-3.145741	5.37632	-0.585	0.561	-13.88617	7.594693
unex	-.0442928	.0496493	-0.892	0.376	-.1434787	.0548932
aveeduc	.6619173	2.017345	0.328	0.744	-3.368192	4.692027
sdeduc	.8693963	1.493096	0.582	0.562	-2.113406	3.852199
aveage	.1997607	.2068287	0.966	0.338	-.2134271	.6129486
age16a25	-7.1588	15.73008	-0.455	0.651	-38.58324	24.26564
notwhpop	-1.17e-11	7.78e-10	-0.015	0.988	-1.57e-09	1.54e-09
bcaveinc	3.61e-15	8.57e-15	0.421	0.675	-1.35e-14	2.07e-14
bcmedinc	4.32e-10	5.70e-10	0.759	0.451	-7.06e-10	1.57e-09
bcunnr	7.94e-10	5.51e-09	0.144	0.886	-1.02e-08	1.18e-08
bc7ed	1.74e-07	2.74e-07	0.635	0.528	-3.74e-07	7.23e-07
fempop	.9061774	4.287695	0.211	0.833	-7.659478	9.471832
faveinc	.0000251	.0000173	1.455	0.150	-9.37e-06	.0000596
fmmedinc	-1.14e-08	7.79e-09	-1.464	0.148	-2.70e-08	4.16e-09
faveeduc	-.6288071	1.998189	-0.315	0.754	-4.620649	3.363035
funnr	-7.81e-09	1.58e-08	-0.495	0.623	-3.94e-08	2.37e-08
momwork	2.885966	4.671064	0.618	0.539	-6.445556	12.21749
manuserv	-2.17e-09	2.30e-08	-0.095	0.925	-4.81e-08	4.38e-08
femhh	7.011935	3.939727	1.780	0.080	-.8585737	14.88244
urban	-1.589697	5.539778	-0.287	0.775	-12.65668	9.477281
urban2	1.316429	4.639811	0.284	0.778	-7.952659	10.58552

violcr1	-.0000632	.0000525	-1.206	0.232	-.000168	.0000415
__cons	-7.750658	9.257154	-0.837	0.406	-26.24395	10.74263

predict yhat

predict e, resid

rename yhat hausyp10

rename e hausep10

Step2:

regress violcr hausyp10 hausep10 avetime medinc gini poor unex aveeduc sdeduc
aveage age16a25 notwhpop bcaveinc bcmedinc bcunnr bc7ed fempop faveinc
fmmedinc faveeduc funnr momwork manuserv femhh urban urban2

Source	SS	df	MS	Number of obs = 90	
Model	49.984546	26	1.92248254	F(26, 63) = 11.61	
Residual	10.4362844	63	.165655308	Prob > F = 0.0000	
				R-squared = 0.8273	
				Adj R-squared = 0.7560	
Total	60.4208304	89	.678885735	Root MSE = .40701	

violcr	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
hausyp10	-.9020247	.0973775	-9.263	0.000	-1.096618	-.7074312
hausep10	-.1089326	.0146764	-7.422	0.000	-.138261	-.0796041
avetime	.35738	.0477805	7.480	0.000	.2618983	.4528617
medinc	.0000973	.0002148	0.453	0.652	-.000332	.0005267
gini	-.6729531	.6699927	-1.004	0.319	-2.011827	.6659204
poor	-2.671554	.6928247	-3.856	0.000	-4.056054	-1.287055
unex	-.0359147	.0077121	-4.657	0.000	-.0513261	-.0205032
aveeduc	1.150631	.2530452	4.547	0.000	.6449601	1.656301
sdeduc	.8497736	.1986345	4.278	0.000	.4528343	1.246713
aveage	.1377815	.0310599	4.436	0.000	.0757133	.1998498
age16a25	-5.22035	1.826125	-2.859	0.006	-8.86957	-1.571129
notwhpop	2.01e-10	9.13e-11	2.199	0.032	1.84e-11	3.83e-10

bcaveinc	5.06e-15	1.06e-15	4.751	0.000	2.93e-15	7.18e-15
bcmedinc	2.74e-10	7.67e-11	3.576	0.001	1.21e-10	4.28e-10
bcunnr	-4.92e-10	6.61e-10	-0.744	0.460	-1.81e-09	8.29e-10
bc7ed	1.91e-07	3.34e-08	5.705	0.000	1.24e-07	2.58e-07
fempop	1.904135	.5024903	3.789	0.000	.8999879	2.908281
faveinc	.0000246	3.07e-06	8.003	0.000	.0000185	.0000307
fmmedinc	-8.11e-09	1.60e-09	-5.084	0.000	-1.13e-08	-4.93e-09
faveeduc	-.9510747	.2488126	-3.822	0.000	-1.448287	-.4538625
funnr	-8.29e-09	1.90e-09	-4.357	0.000	-1.21e-08	-4.49e-09
momwork	2.408234	.6684487	3.603	0.001	1.072446	3.744022
manuserv	-1.30e-08	2.84e-09	-4.583	0.000	-1.87e-08	-7.33e-09
femhh	5.460784	.9086254	6.010	0.000	3.645042	7.276527
urban	-3.303268	.6673562	-4.950	0.000	-4.636873	-1.969663
urban2	2.203372	.5584779	3.945	0.000	1.087344	3.319401
_cons	-2.843023	1.37466	-2.068	0.043	-5.590061	-.0959841

Conclusion: Simultaneity cannot be rejected as the error term is significant (99% level of confidence).

APPENDIX F

**SUMMARY STATISTICS OF DEPARTMENT OF JUSTICE PRODUCTION
FUNCTION VARIABLES**

Table F.1: Descriptive Statistics of the Available Output and Input Variables

Variable	Number of Observations	Mean	Standard deviation	Minimum	Maximum
Probability of Conviction, given Prosecution (Overall Crime)	12	0.384383	0.0137	0.36401	0.41101
Number of Personnel	12	38763.67	2224.897	32315	40556
Number of Cases to Court	12	131816.2	4682.392	122838	139116
Population Number	12	4.18e+07	817016.9	4.06e+07	4.31e+07
Population Density Per Square Kilometer	12	34.28498	0.6701858	33.27192	35.31676
Average Years of Service	12	12.6375	0.8303463	11.17	13.51

* It should be noted that as no information was made available regarding the number of convicted criminals sent to prison, the probability of receiving a prison sentence, which is an additional output determined by the Department of Justice, cannot be considered in relation to departmental inputs.

* No information regarding capital inputs, computers or vehicles, in the Department of Justice is available.

* To calculate the size of the national population, the quarterly provincial population figures were summed. The national population density was calculated from this figure by dividing it by the size of South Africa in square kilometers.

APPENDIX G

SUMMARY STATISTICS OF PRODUCTION FUNCTION MODEL VARIABLES

Table G.1: Descriptive Statistics of Output and Input Variables in the South African Police Service Model

Variable	Level	Mean	Standard deviation	Minimum	Maximum	Number of Observations
probcort	overall	0.2821614	0.0699688	0.1324922	0.4865572	N = 108
	between		0.0646867	0.1635146	0.3781967	n = 9
	within		0.0337852	0.1879221	0.3905219	T = 12
propcort	overall	0.2125528	0.0571742	0.0995932	0.3762436	N = 108
	between		0.1192894	0.0540934	0.2848572	n = 9
	within		0.0253695	0.1200293	0.3057719	T = 12
violcort	overall	0.3472023	0.0988698	0.1472286	0.6247446	N = 108
	between		0.0799743	0.2006042	0.4947559	n = 9
	within		0.0635363	0.2081912	0.4943093	T = 12
people	overall	14693.66	8478.635	3765.435	34706.22	N = 108
	between		8935.683	3920.808	32868.13	n = 9
	within		499.3341	13312.82	16531.74	T = 12
compexp	overall	5124679	6453053	-1090498	3.70e+07	N = 108
	between		3107521	1368069	1.14e+07	n = 9
	within		5742643	-6085645	3.07e+07	T = 12
motorexp	overall	1.53e+07	9792894	2165846	5.14e+07	N = 108
	between		9247251	4486801	3.44e+07	n = 9
	within		4379501	2082738	3.23e+07	T = 12
totalcr	overall	58929.7	39780.33	13598	159976	N = 108
	between		41777.26	15541.33	147855.8	n = 9
	within		4069.717	45987.7	71049.87	T = 12
propcr	overall	40625.87	30666.88	8021	120664	N = 108
	between		32206.31	8756.083	111618.6	n = 9
	within		3137.446	30863.79	49671.29	T = 12

Variable	Level	Mean	Standard deviation	Minimum	Maximum	Number of Observations
violcr	overall	18683.94	10799.49	5248	48749	N = 108
	between		11223.19	6478.333	42127.92	n = 9
	within		1902.147	13371.02	25305.02	T = 12
pop	overall	4644053	2399458	839908.7	8924643	N = 108
	between		2530984	857068.8	8662423	n = 9
	within		100348.5	4394309	4906273	T = 12
popdense	overall	82.15068	131.0123	2.32128	458.9814	N = 108
	between		138.2794	2.368706	445.0365	n = 9
	within		2.961225	68.88975	96.09556	T = 12
serveyrs	overall	7.884815	1.080769	6.29	11.08	N = 108
	between		0.9783232	6.790833	9.959167	n = 9
	within		0.5561847	7.019815	9.279815	T = 12
prov2	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
prov3	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
prov4	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
prov5	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
prov6	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
prov7	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
prov8	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12

Variable	Level	Mean	Standard deviation	Minimum	Maximum	Number of Observations
prov9	overall	0.1111111	0.3157348	0	1	N = 108
	between		0.3333333	0	1	n = 9
	within		0	0.1111111	0.1111111	T = 12
time2	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time3	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time4	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time5	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time6	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time7	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time8	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time9	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time10	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time11	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12
time12	overall	0.0833333	0.2776739	0	1	N = 108
	between		0	0.0833333	0.0833333	n = 9
	within		0.2776739	0	1	T = 12

In terms of this interdisciplinary theory of crime causation, the influence of law enforcement, economic and socio-economic variables on crime are considered. As a result of this interdisciplinary approach, considerably more insight is gained regarding the variables which can be manipulated in order to raise the net earnings from legitimate activities and/or reduce the net earnings from illegitimate activities in order to prevent crime. The focus is no longer solely on raising the expected punishment cost of committing crime via criminal justice system activities in order to lower the crime rate. Not only is this the focus of the traditional economic theory of crime, but it is also to a great extent the current practice in crime prevention worldwide. In terms of the interdisciplinary theory of crime causation, it is possible to assess the merits of both traditional practices and theories as well as alternative proposals. Essentially in terms of an interdisciplinary theory of crime the activities of all government agencies, not only the criminal justice system, must be considered regarding their ability and effectiveness in crime prevention.

2.6 CONCLUSION

An important objective of this study is to investigate some of the possible causes of the high crime rate in South Africa. The conventional economic theory of crime was considered and it was determined that the main focus of economists has been on the influence of law enforcement variables on crime, although the economic model of the market for offences also suggests the importance of economic and socio-economic variables. In this study, however, the model of the market for offences was considered in its broadest sense as a paradigm for an interdisciplinary theory of crime.

An interdisciplinary approach to crime causation contributes substantially to the theory of crime. In terms of an interdisciplinary theory of crime, a framework for analysis is provided that identifies, orders and systematizes the various theories concerning crime causation. Within this framework it is easily recognised that the traditionally narrow focus of the economic theory of crime on law enforcement variables, inevitably lent itself to the exclusive use of the criminal justice system in crime prevention. Yet in South Africa and worldwide increased public expenditure on the criminal justice system is not reducing crime. An interdisciplinary theory of crime provides an integrated and consistent framework for a shift