UNIVERSITY OF CALGARY

Gendered Crime Rates and Unemployment:

A Cointegration Analysis of the Easterlin Hypothesis

by

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ABSTRACT

The initial intent of this research was to address the existence of criminal convergence between the sexes. Subsequently, through the use of cointegration techniques, further analyses of the long term relationships between age and sex-sensitive unemployment rates, population age-structure and crime were undertaken. These relationships were calculated for both sexes generally as well as by age groups. Several differences were uncovered between the age categories and the sexes. Annual time series data were derived from the Canadian Uniform Crime Reports for the period 1962-1997. Population figures for males and females over the same period were also used as measures of Easterlin's large cohort competitive strain. The ultimate goal was to develop error-correction models which would explain crime as primarily a function of the demographic makeup of the nation, with the additional possibility of independent effects of unemployment. Also, careful examination of crime trends, as well as indications from government publications, issued a challenge to the orthodox understanding of the age-crime relationship.

ACKNOWLEDGEMENTS

Many people deserve recognition for their assistance, both active and passive, throughout this project. Although many enjoyable adventures have resulted from unplanned actions, embarking on a task of this magnitude without a clear destination and regular check-points would be foolhardy. Fortunately, my experienced guide, Dr. Augustine Brannigan, ensured that deviations from the path toward completion were only temporary. The countless hours of formal discussion and many more of casual conversation have brought clarity to a topic which often seemed opaque. Thank you for your concern, support and energy.

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DEDICATION

For my wife Cynthia and my mother Marie Dorval (1932-1998)
The woman that I love and the woman who taught me how.

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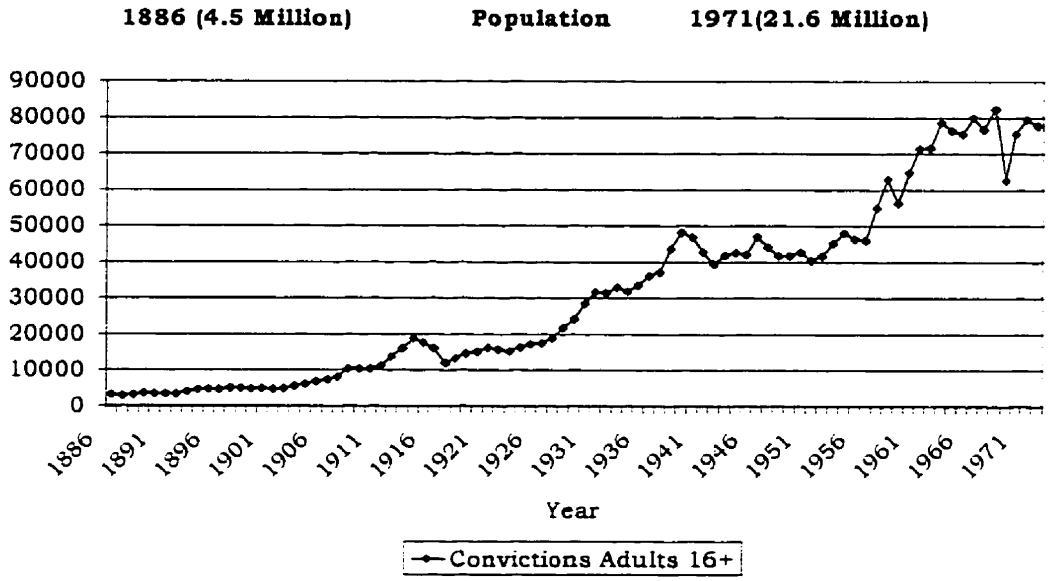
Chapter 1 Canadian Crime Trends:

Gender, Age and Sex Specific Explanations

Fear of being victimized by crime and the detailed coverage of crime in the media leaves us with justified concern, if not for our persons, at least for our community's well-being. These sentiments are not new. Canadian data reaching back to 1886 portray a steadily increasing number of criminal convictions for adults. Starting with less than 5,000 convictions in the nation in 1886, Canada's adult convictions skyrocketed to nearly 80,000 in 1970 (see Figure 1.1).

Figure 1.1: Convictions (All Adults 16+) - Canada



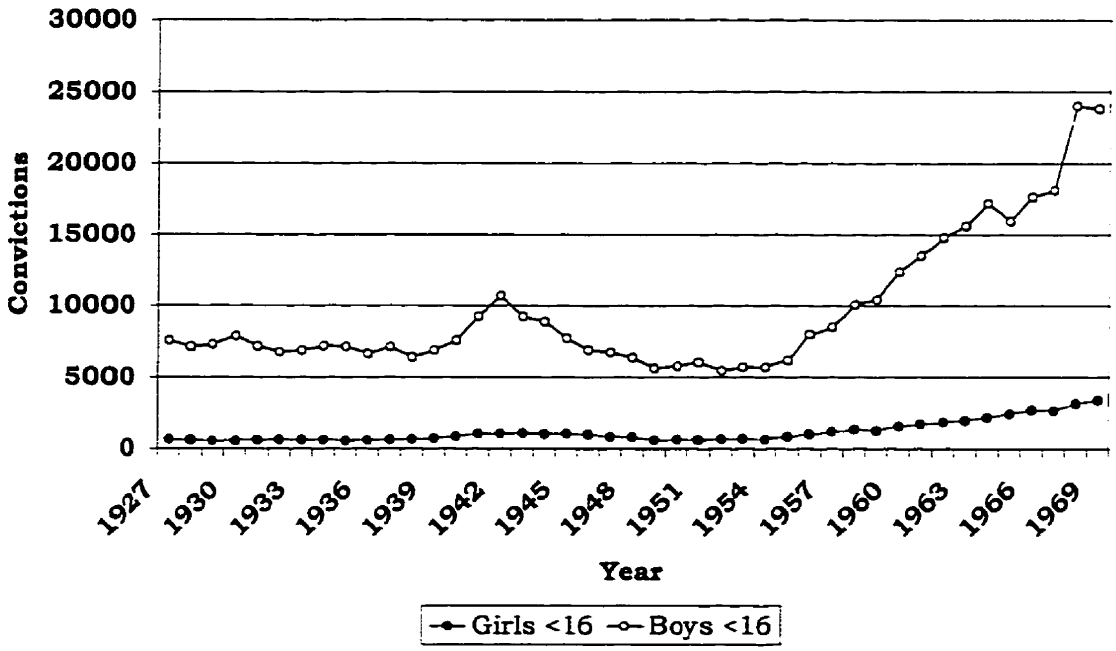
Source: 1961–1972, Statistics Canada Catalogue #85-201
1886-1960, Historical Statistics of Canada, Series Y1-Y13

Of course these yearly absolute figures cannot be directly compared because of the parallel increases in population. Also, the changing nature of policing and changes in legal definitions, which also occurred simultaneously in the 84 year period, make direct comparisons over long time periods difficult. A crime rate is undoubtedly more informative to assert true changes in crime. Still, the number of convictions has increased sixteen times while the

population has increased only about five or six times indicating that both crime rates and absolute values of crime have shown substantial increases over time.

One phenomenon that cannot be disputed is the unfailing discrepancy between the criminal behavior of males and females. Understanding that proportions of males and females in younger age categories are quite similar, Canadian data from 1927-1969 clearly shows that boys under age sixteen were ruled by the courts to be delinquent in far greater numbers than females in the same age group (see Figure 1.2). Indeed, the disparity between youth male and female criminal activity persists into adulthood. Canadian data for 1997 indicate charges for property and violent offenses combined totaled 343,655 with young males being charged in 18.3 % of the cases, compared to 5.5% for young female offenders. In total, males of all ages were responsible for 80.2% of the arrests while females made up the remaining 19.8%. It seems clear that at an aggregate level equality of the sexes has not yet permeated the realm of criminal involvement.

Figure 1.2: Delinquency Convictions By Sex, Canada (1927-1969)

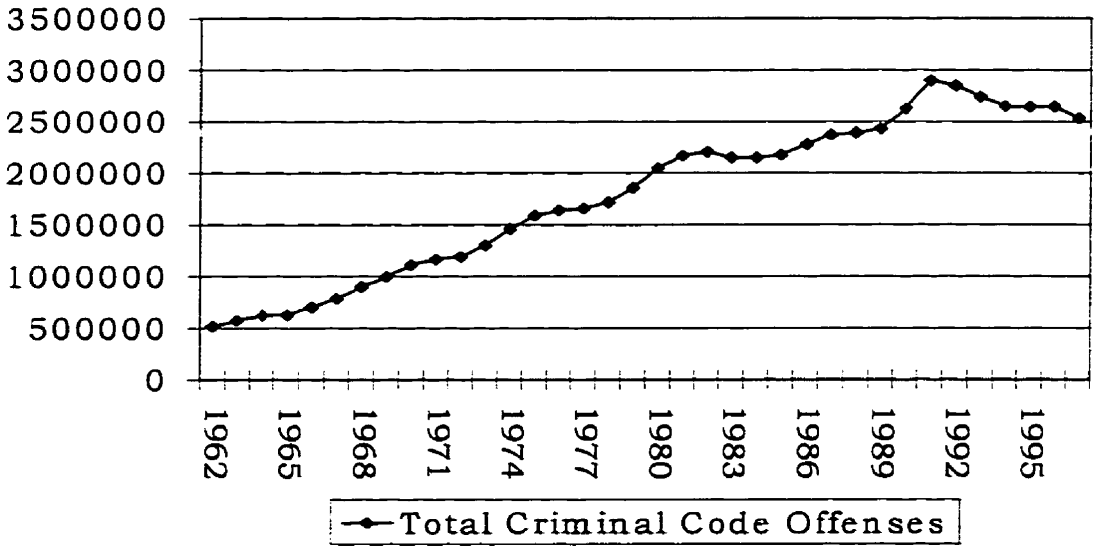


Source: Historical Statistics of Canada, Series Z 267-268

Despite falling overall crime rates since 1991 (Figure 1.3), the problem of crime remains a high priority. Whether people are statistically safer now than they were in the last decade is of little comfort to those who increasingly hear of violent crime in their community. Young offenders of both sexes are also of particular concern because of their increasing activity in violent and sensational crimes previously thought to be the exclusive domain of adult males. Socially and politically, youth crime is a hot button issue. In a US presidential campaign speech in 1996, Republican candidate Bob Dole spoke of:

> "a 'crime pipeline', in which rising teenage drug abuse feeds through to the rising teenage crime. A third of all violent crimes, Mr. Dole said, are now the work of teenagers. The president appointed liberal judges who sympathize with criminals; he has run up the white flag in the war on drugs". Therefore the rise in teenage crime was Clinton's fault. [I]ndeed, the day after Mr. Dole's speech, new figures revealed that the number of violent crimes reported in 1995 was 9% lower than the previous year. (The Economist, 21/09/96: 25)

Figure 1.3: Total Criminal Code Offenses, Canada: 1962-1997



Source: Statistics Canada, CANSIM Series D9501

Public perception of criminal activity determines the amount of individual concern placed on the issue. A close reading of statistics is little comfort when both entertainment and information media choose to increase the reporting of criminal activity and downplay the dropping crime rate. Increasingly, statistical "truths" are muted by selectivity in the reporting of crime, resulting in a general lack of public awareness that crime rates have actually decreased.

Despite the immense calculation power readily available in desktop microcomputers in addition to increasing data accessibility, seemingly basic statistical questions remain in dispute. Some report the clear fact that recent crime rates seem to be on a steady downward trend (Blumstein, 1998) and still others believe that the trend is merely a function of recording practices and enforcement imperatives (Black and Reiss, 1970; Visher, 1983). Still others compare male and female criminal behavior and see either a continued chasm between the sexes (Steffensmeier, 1978; Steffensmeier and Steffensmeier, 1980; Steffensmeier and Allan, 1990) or a narrowing of the gap (Adler, 1975; Austin, 1982, 1993; Smart, 1979; Hill and Harris, 1981). Lack of unanimity in the academic world over the extent and existence of higher relative gains in female criminality causes readers to accept *conclusions* tentatively. Some researchers have explored the phenomena extensively only to conclude that there are more similarities than differences between the movement of gendered crime rates. Hartnagel (1982), in a forty-nation study of the effects of modernization and female social roles on nonviolent property crime, found that the results were similar to those for general property crime irrespective of sex. Furthermore, recent research exploring the parity of male and female crime patterns (Lieber et al., 1994) and the similar effect, although perhaps different magnitude, of strain on the isomorphic pattern of sex-specific crime rates (Broidy and Agnew, 1997) suggests that the belief in non gender-specific theories of crime remains entrenched.

Using Canadian arrest data[1] for adults and juveniles of both sexes spanning the years 1962 to 1997, this research will attempt to clarify some of

[1] The data for this research were gathered through the use of various publications in both paper and electronic form. A detailed discussion of the sources of the data will follow in addition to a summary list included as table 2.1

these complexities. It attempts to make sense of the changing aggregate levels of crime in Canada. The data provide an excellent opportunity for long term comparisons across age groups, gender and particular offense categories. First, we will attempt to discern for which crimes and to what extent, if any, criminal convergence between the sexes has occurred. Second, with an understanding of the age-crime relationship, a further analysis will be undertaken to determine whether crime rates change as a function of changes in the supply of crime-prone persons. In addition to the changing demographic makeup of the nation, we further ask whether economic indicators (unemployment rates) over the time series provide additional sources which drive the changing directions of various crime trends up and down over the thirty-six year period.

With gender convergence in crime accepted as fact by some and dismissed by others, the topic of causative micro and macro predictors of this convergence has prompted intense theoretical debate. Still, much of the research suffers from minimal statistical significance because of failure to adequately account for the two variables that outperform virtually all others – age and sex (Hill and Harris, 1981). When included in a predictive model, age and sex stand as the strongest predictors of crime (Gottfredson and Hirschi, 1990: 123-149). Criminal involvement of young males, both currently and historically, has occurred at a level many times that of females. It is contended that this generally agreed upon fact has led many to *falsely* assume that male and female crime rate behaviors are caused by different factors. One motive of this research is to demonstrate that although female crime trends remain very different in magnitude when compared with male crime, there is still an underlying dynamic process which moves the rates in unison over time. By this, the idea of a common attractor process is put forward suggesting that male and female crime trends respond in a similar fashion to changes over time. Still, the differing levels of criminality between the sexes is much more complex and remains largely concealed when using aggregated official crime data.

The Canadian situation can be comparatively displayed over the time period commencing in 1962 and ending in 1997. The start date represents the beginning of Uniform Crime Reporting in Canada and the end point marks the

limit of existing data. The following figures allow a comparison of age and sex categories for two selected crime types (figures 1.4 and 1.5), as well as the generic categories of property crime and crimes against the person. In the largest property crime offense category of "theft under"[2], we can clearly see that the percentage of total arrests for this crime attributable to each gender and age category have changed. From figure 1.4, we can see that the total female responsibility for "theft under" increased with values of 11.3%, 31% and 30.9% for the years representing the beginning, midpoint and end of the series. Still, combined male percentages (adult and juvenile) have always represented the majority of "theft under" charges through the series. Males were responsible for 88.7%, 69%, and 69.1% respectively in the years displayed.

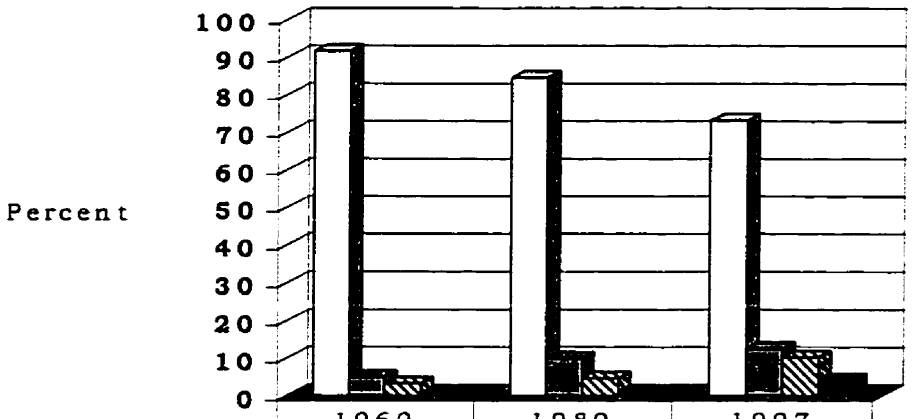
Figure 1.4: Theft Under by Age and Sex

	1962	1980	1997
Adult Males	61	51.6	49.7
Adult Females	8.5	25.6	21.6
Juvenile Males	27.7	17.4	19.4
Juvenile Females	2.8	5.4	9.3

[2] This category has experienced considerable change over the thirty-six year span of data collection: (1962-1971) <$50 , (1972-1985) <$200, (1986-1994) <$1000, (1995-present) <$5000.

For non-sexual assault[3], the pattern remains similar with the combined male percentages accounting for 94.7%, 89%, and 83.3% for the years 1962, 1980, and 1997 respectively. Women have clearly contributed a minority share in non-sexual assault arrest statistics, even though their contribution has increased from 5.3% to 16.8% (figure 1.5). Furthermore, these graphs show that the juvenile contribution has fluctuated considerably over the three data points for both "theft-under" (30.5%, 22.8%, 28.7%) and for assault (3.6%, 5.7%, 14.4%). Due to this point, some have argued that the juvenile violent crime problem is of grave concern. That may be the case but it certainly is not conclusive based on the preceding graphs because they fail to account for the changing age composition of the country and the number of persons in the crime-prone age categories.

Figure 1.5: Assault (Non-Sexual) by Age and Sex

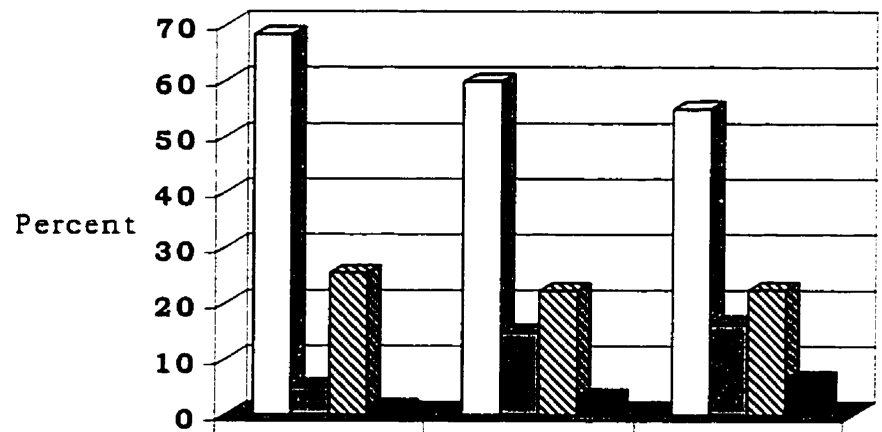


	1962	1980	1997
Adult Males	91.5	84.4	73.1
Adult Females	4.9	9.9	12.5
Juvenile Males	3.2	4.6	10.2
Juvenile Females	0.4	1.1	4.2

[3] Non-sexual assault was used as the comparison category across genders because total assault (including sexual assault) would have produced biases in favor of male totals which may have been misleading as female arrests for sexual assault are comparatively miniscule.

When crime *categories* are used as the measure for comparison, the patterns remain much the same. Figure 1.6 shows that females contributed 6.4%, 18% and 22.7% toward the total "property crime"[4] charges over the three respective years. Adults continued to be charged with the majority of property offenses with juvenile offenders being responsible for 26.8%, 25.4% and 28.8% of the total. Figure 1.6 also indicates that the contributions made by both females and juveniles in "theft-under", arguably one of the less severe property offenses[5], is greater than their involvement in total property crimes.

Figure 1.6: Property Offenses by Age and Sex



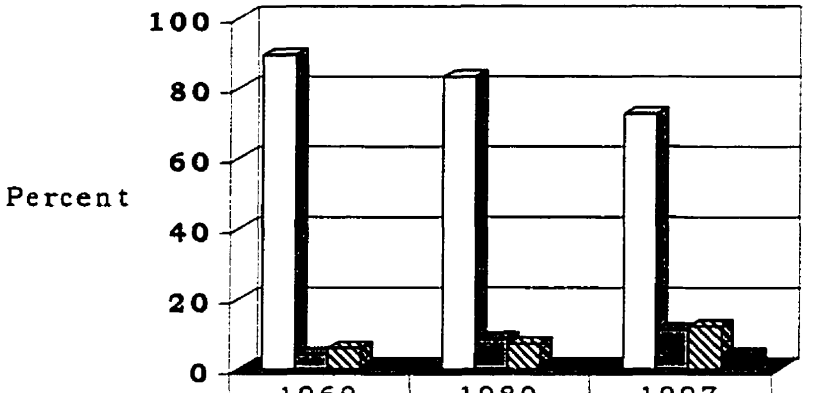
	1962	1980	1997
Adult Males	68.2	59.8	54.9
Adult Females	5	14.8	16.3
Juvenile Males	25.4	22.2	22.4
Juvenile Females	1.4	3.2	6.4

Violent crimes[6] are also dominated by males with 95.3%, 90.3% and 84.7% of all violent offense charges being laid against males. Juveniles account for a much smaller percentage than those indicated in the earlier quotation

[4] Property crimes, as reported by the Canadian Center for Justice Statistics, include break and enter, theft over, theft under, motor vehicle theft, possession of stolen property and fraud.
[5] For example, shoplifting, theft from motor vehicles and theft of bicycles accounted for 65% of "theft under" in 1995.
[6] Violent crimes, as reported by the Canadian Center for Justice Statistics, include homicide, attempted homicide, robbery, assault, sexual assault, abduction and kidnapping.

from Bob Dole (at least in Canada), contributing only 6.5%, 8.3% and 16.2% of total violent crime (figure 1.7).

Figure 1.7: Violent Offenses by Age and Sex



	1962	1980	1997
Adult Males	89.3	83.1	72.6
Adult Females	4.2	8.6	11.2
Juvenile Males	6	7.2	12.1
Juvenile Females	0.5	1.1	4.1

The following review of the literature will assess the state of the debate and the various perspectives used to explain what many thought to be the genesis of a new female criminal. These perspectives will be compared with explanations focusing on the differences in motivation and opportunities for crime as well as demographically based causes. Initially though, a review of the generally accepted facts regarding age, gender and crime will provide an appropriate stage for these differing positions.

The Controversy Over Changing Crime Levels: The Roles of Gender, Age and Social Change

In understanding the changing crime levels in society, topics that eventually enter the fray are the prevalence of various types of crime and the direction of the crime rate relative to the past. Also, comparisons are often

made cross-culturally and across the sexes. Complications arise when definitional conflicts over crime classifications and quantification create empirically different findings, often using the same time period. Whether researchers choose to use arrest reports produced by the police, conviction reports aggregated by the courts, self-reports or victimization reports, the "crime problem" can be reported with markedly different levels of urgency. Furthermore, crime data can be portrayed in various ways with their interpretation being largely dependent on the method used.

Whether research presents crime trends as absolute numbers for males and females, as rates of involvement by gender, as percentage change by gender or as proportion of crime attributable to each sex, the resultant message can be quite different. Rates tend to show modest change over time but are sensitive to population variation whereas absolute values are of only partial utility because of the absence of control for population changes (Steffensmeier and Steffensmeier, 1980). Presenting female proportions of arrest in crime tends to downplay annual variation and to highlight the resilience of gender differences in crime. But the presentation and comparison of gender specific crime statistics by percentage change over a time series is undoubtedly the most contentious technique because of its tendency to exaggerate the changes for female crime while downplaying changes in male crime (Balkan and Berger, 1980; Box and Hale, 1983).

As an illustration, juvenile female arrests for non-sexual assault comprised 0.4%, 1.1% and 4.2% of the total charges in 1962, 1980 and 1997 respectively (refer back to figure 1.5, p.7). The message can be delivered in various ways depending on the perspective of the researcher. It could be stressed that 95.8% of all arrests for assault remain attributable to males and adult females clearly stressing that juvenile females continue to account for a small percentage of assault arrests. It could also be stated that juvenile female assault increased by almost 275% from 1962 to 1980 and 382% from 1980 to 1997. During the same two reference periods, juvenile males have increased their involvement in assault by 44% and 220% respectively. Clearly, some statements implicitly downplay any of the change while others, although accurate, can falsely impart a sense of urgency on the phenomenon. All the

above statements are true but lead one to different conclusions depending on the information available regarding the methods used in calculating the values. Although an unusual reference in the context of criminology, a cautionary summation of many crime trend reports can be found in *Mark Twain's Own Autobiography*, "[f]igures often beguile me, particularly when I have the arranging of them myself...:[t]here are three kinds of lies: lies, damned lies and statistics" (Kiskis, 1990: 185).

The institutional biases which have been argued to exist in the police organizations and courts may in effect create the perception of crime by emphasizing or downplaying certain criminal activities. This can be accomplished through the differential use of official versus informal methods of social control from one period, or one group of people, to the next (Visher, 1983). Still, the reassuring pattern regarding the recently declining crime rates has refueled a debate which struggles to make sense of, and often take credit for, the phenomenon.

Political figures raise the issue of a declining crime rate and imply that the current government stance on crime has resulted in a safer society. Police organizations also present the statistics as an indication that their presence in the community and their ability to monitor criminal activity is somehow superior to what it was in the past. This provides a causal connection for the public regarding policing and crime which may not exist to the degree that it is promoted (Steffensmeier and Harer, 1991). The recent case of Mayor Rudolph Giuliani and Police Commissioner William Bratton in New York City illustrates exactly this point. In March of 1996, the ousting of Mr. Bratton was reported in the context that:

> "In the 27 months since Mr. Bratton took office, serious crime in New York has fallen by 32%, to its lowest level since the 1960's. . .and although Mr Bratton cannot take credit for all of this (changing demographics and a decline in the use of crack cocaine have helped) it is hard to spot Mr. Giuliani's role apart from appointing the commissioner" (The Economist, 30/03/96: 31).

Eighteen months later, with an election looming and the polls suggesting an easy victory for the incumbent Giuliani, the reasons for his popularity, as suggested by opinion polls, were ". . .falling crime and the booming economy.

Yet the extent to which these are the result of Mr Giuliani's Mayoral skills is debatable" (The Economist, 27/09/97: 27). The reasons behind economic prosperity and declines in crime are complex and varied but regardless of the alternate causes, political figures clamor to receive their accolades. Not surprisingly, they are apt to interpret the causes for negative trends more critically.

With promising statistical information indicating a safer society, it perhaps may seem cynical to attempt to demonstrate the presence of errors in the interpretation of these figures. Criminologists, both theoretical and quantitative, have challenged the rhetoric that society has managed to regain some control over the criminal element that was feared to have the upper hand during the past four decades. The ongoing debate in the criminological literature does not argue against the downward overall crime trend, but rather takes issue with the purported causes of the decrease. In 1997, Forbes reported the sentiment, representative of views held by many demographers and sociologists (Maxim, 1985; Jolin and Gibbons, 1989; Steffensmeier and Harer, 1991), that the current downward trend in crime may be fleeting. Brimelow (1997: 48) concluded that

> (t)he proportion of young men in the population has been falling since 1980 and the 1946-1960 baby boom has aged. [The proportion of young men] is at its lowest point since 1980—which all by itself explains much of the current crime lull. Now, however, the proportion of young men in the population is going to increase, reflecting babies already born.

Furthermore, there are arguments raised that question whether there is less reason to fear crime today or merely certain types of crime. Also, over the past three decades, there have been indications in the research that there may be a new factor to consider: the female criminal.

Women and Crime: Competing Perspectives

International time series analyses suggest that female involvement in crime is on the rise and "gender role convergence" theorists have warned that females are increasing their involvement in criminal activity. With reactions ranging from curiosity to panic, researchers have revisited historical crime data to substantiate the claims of a new female criminal. Nearly twenty five years

ago, Freda Adler (1975) warned of this phenomenon and laid the groundwork for what would become an often controversial field of study. Adler (1975:15) stated that the struggle against stereotypical gender roles and continued gender discrimination was responsible for this change being witnessed in female crime trends:

> Like her legitimate-based sister, the female criminal knows too much to pretend, or return to her former role as a second-rate criminal confined to "feminine" crimes such as shoplifting or prostitution. She has had a taste of financial victory. In some cases, she has had a taste of blood. Her appetite, however, appears only to be whetted.

This cautionary statement, albeit somewhat alarmist, was greeted harshly by female and male criminologists of the period. By implication, this recent trend in crime would be appended to other changes occurring at the time. The contemporaneous social situation for women had undergone an ideological, if not yet practical, revolution. The organization of women for the purpose of effecting change on what women perceived as society's systematic patriarchal oppression took legitimate form with the establishment of the National Organization of Women (NOW) and the "Women's Liberation Movement". The effective start date for this movement is often suggested to be 1966, coinciding with the official recognition of NOW. The **liberation / emancipation** hypothesis put forward the idea that the new freedoms available to women and the gender equalization of opportunities have had some of the expected social outcomes as well as unfortunate latent results. By this reasoning, the movement increased female labor force participation, introduced greater aspirations for independent material wealth in women and unfortunately a greater propensity toward historical "maleness" in the form of criminal activity.

A second perspective was introduced which suggested that women were *not* liberated or emancipated by the women's movement, but rather that there was now an underlying feeling of strain in the female population which was a result of the unfulfilled promises of equality. These women were faced with a transition from the traditional oppressed domesticity of the housewife-housemother roles to low paying jobs offering minimal satisfaction, often with the added strain created by single-parented households. Women, according to

the **marginalization** hypothesis, were in a position where expectations of immediate success and equality were being raised in a social framework where equality existed in principle but not in practice.

A third hypothesis emerged to suggest that women were merely becoming involved in crime as a result of increased opportunities that were revealing themselves over the time period in question. If, as Ambrose Bierce suggested, "(t)he honorable [person] suffers that keenest of ills, (a)n impediment of [their] reach", economic opportunities remedied this deficiency (Bierce, 1958: 58). Women, it was asserted, were now able to commit theft by virtue of the fact that there were more things to steal. Furthermore, more jobs were open to women resulting in increased opportunities for theft from employers. Similarly, but to a lesser degree, it was argued that women were participating in crimes against the person because they were not confined to their homes in the traditional domestic role. Consumer goods became smaller, lighter, more easily concealed and more plentiful than ever before. By extension, women, who continued to do most of the shopping for the home, were in the presence of these goods more often than their male counterparts. Basically, criminal convergence from this **opportunity** or "**routine activities**" perspective assumes that the rise in female crime is in large part a function of their increased involvement in property offenses and petty theft specifically, perpetrated alongside their traditional role activities.

A related issue arising from the opportunity hypothesis is whether women are becoming more criminal in *all* categories of crime or merely in the property offenses. Adler (1975) stated that women were becoming more equal to men in even the most violent crimes. Is the evidence consistent with this thesis? Or, is convergence limited to property offenses? And, are women's rates remaining relatively stable compared to males in their participation in crimes against the person? Some studies (Austin, 1982 ; 1993) have provided weak support for an increase in violent female crime. Others flatly deny the existence of role convergence for violent crime *and most property crimes* (Steffensmeier and Steffensmeier, 1980; Steffensmeier, Rosenthal and Shehan, 1980). Such variations in findings may be attributed to the methods used in measurement

and the inconsistent use of cumulative crime indexes versus individual crime types as the dependent variable.

Before undertaking a detailed examination of the particular themes emerging from the literature regarding criminal convergence between the genders, some of the basic facts regarding the interrelationships between age, gender and crime will be addressed.

Age and Crime

Just as the gender-crime relationship has been the subject of much controversy, the contribution of age has been no less contentious. Demographers stress the changing proportions of the "crime-prone" or "at risk" population over time. Shifts in the "supply" of males and females in the crime prone years will contribute to crime independent of any role convergence effect. Gottfredson and Hirschi (1983, 1990) make clear the fact that crime is very much a young male enterprise and explicitly that criminal activity rises steeply through the teenage years to the early-twenties and then drops steadily over the life course. According to their view, the existence of a new female criminal is not borne out by the existing data. If women are becoming more criminal, so too are males. According to their general theory of crime, there is an underlying process of low self-control which serves to propel adults and youth of both genders into crime, but the effect of low self control is considered to independent of the profound effect of age.

Gottfredson and Hirschi (1983: 553) suggest that, "there is reason to believe that age could replace social class as the master variable of sociological theories of crime". These authors stress that the shape of the age-crime curve is invariant across societies, cultures and gender. They graphically show that the pattern of peak and decline maintains its shape and form regardless of the types of data used or the period studied. Furthermore, these authors are able to demonstrate that the form of the relationship between age and crime persists in relatively homogeneous criminal locales like prisons. Interestingly, the pattern holds in non-criminal but analogous behaviors like proneness towards automobile accidents (Gottfredson and Hirschi, 1983: 562). Gottfredson and Hirschi (1983: 557) further indicate that the shape of the distribution remains

very similar for both violent and property crimes, even if self report data were analyzed rather than official data. This is in mild contrast to the traditional understanding of property crime as the domain of the crime prone 15-24 age group whereas crimes against the person are generally believed to cluster at slightly older ages.

Not only does the age-crime curve present itself in a predictable way for those studying age of onset of criminal behavior, it also predictably declines when "...maturational reform or some equivalent unexplained process takes over" (Hirschi and Gottfredson, 1983: 564). By extension, theoretical criminology, which often can claim an ability to explain the onset of crime (using such theories as differential association and strain), cannot adequately account for why certain adolescent criminals continue into adult crime while others do not. This failing to account for both sides (the upward and downward slopes) of the modality in the distribution successfully places any theory of crime in jeopardy (Hirschi and Gottfredson, 1983: 564; Lieberson, 1987: 64).

This recognition of the relationship between age and crime through all societies where data exist suggests that responsible research on trends in crime rates must account for age composition of the population. There has long been agreement that for property crime, those members of the population less than thirty years of age perpetrate the bulk of crime. Violent crimes tend to decline more slowly with age but experience their peak later than property offenses (Sagi and Wellford, 1968; Gottfredson and Hirschi, 1985; 1990). Recent publications by Statistics Canada suggest that the age-crime relationship may not be as straightforward as reported (Juristat Bulletin, 1996; 1997). Age distributions by crime category produced in Juristat publications for 1996 and 1997 indicate that the median ages for violent crimes and property crime are 29 and 24 years respectively but the *simple* and *predictable* shape, based on the literature, is not evident. The reason for this topic's presence at the outset of the theoretical discussion seems obvious. Before anything else can be understood about trends in crime or criminal convergence, there must be an awareness that just as gravity is a natural law of physics, so too is age with respect to crime (Gottfredson and Hirschi, 1990: 124; cf. Goring 1913). Moffitt (1993) notes that in Farrington (1986) it was found that by the mid- twenties,

70% of subjects were expected to cease all offending. Though greater discussion of the patterns of the age-crime relationships will be in order later, suffice it to say for the time being that the relationship, although treated as an invariant law, is more complex than the preceding discussion suggests.

Sex and Crime Statistics: The Persistence of the Criminal *Man*

Except for morality offenses, crime is generally viewed as a male activity. Despite arguments contending that this trend is in fact changing, criminal perpetrators of virtually all types of crime continue overwhelmingly to be men. Not only in Canada but also cross-nationally, the male rate of criminal activity consistently exceeds that for women. Hartnagel (1987: 81) provides evidence from the United States Uniform Crime Reports stating that in 1983, males over sixteen years of age comprise 77% of all arrests while in Canada that same group accounted for 71% of all Criminal Code offenses. As noted earlier, males were responsible for 80.2% of total violent and property crime for 1997 in Canada (calculated from CCJS QuickStat, 1998).

This being said, there are variations in this gender gap when different categories of crime and specific offenses are taken into consideration individually. Females in the US and Canada, although historically and contemporaneously under-represented in violent crime arrests, have experienced noticeable growth in their participation in property crime offenses. Larceny-theft arrest represents 20% of all female crime and 80% of the "most serious offenses", committed by females, included in the US crime index. There are also clear indications that arrests for fraud and embezzlement are showing some convergence (Hartnagel, 1987, Hartnagel and Gibbs Van Brunschot, 1994). Still, Canadian UCR arrest data show that violent crime remains the domain of males. Of the total violent crime arrests in Canada for 1997, adult males accounted for 72.6% while juvenile males were responsible for 12.1%. This leaves a substantial but comparatively minor total of 15.3% of all violent crime perpetrated by all females (CCJS QuickStat, 1998). In 1962 and 1980, the percentage of violence attributable to males was 95.3% and 90.3% respectively. These findings would again seem to indicate that Adler (1975) may have overestimated the prevalence of violent female criminals.

Some of the evidence put forward supporting the case for convergence for female violence may have been misleading and overstated because, as noted earlier, percentage change comparisons of female and male participation were used. With the denominator in all female crime categories being so consistently small when compared to males, comparatively small increases in female crime can create rather large percentage differences when viewed in a time series. Similar percentage changes in male crime would require a much greater increase in absolute crime values (Austin, 1993: 451).

Even if there is a limited amount of convergence occurring for certain crimes, continued disparity and even divergence for others make it theoretically compelling and challenging to tease out the causal differences. Before testing various theoretical possibilities in an area as diverse as criminal motivation, there must be careful identification of the dependent variables to be measured. This identification, as will be demonstrated, has not been unanimously agreed upon. Moreover, maintaining consistent data over long periods of time amid definitional differences of particular crimes, recording practices, and the changing official treatment of women by the police over the last several decades pose additional concerns.

These problems are of particular importance in time series analysis, arguably the best technique for conducting such research. There must be a constant awareness of the year-to-year consistency of the data collection and recording practices. Also the research must pay careful attention to potentially confounding societal events, which may impact the integrity of the data related to either of the sexes or particular offenses.

Liberation, Emancipation and Empirical Studies of the Female Criminal

The changing social climate for women in the latter half of this century resulting in increased opportunities for employment and self sufficiency has provided some criminologists with temporally and theoretically compelling explanations for the increase in female criminality. Here we review some of the key empirical investigations. Researchers, through the use of both time series and cross-sectional data from Canada, the United States and many other nations, have formulated and tested the connection between female "liberation"

and criminal tendencies (Simon, 1976; Fox and Hartnagel, 1979; Steffensmeier et al., 1980; Steffensmeier and Steffensmeier, 1980; Hartnagel, 1982; Hartnagel and Mizannudin, 1986). By this liberation hypothesis it is suggested that the advancements of women brought about since the women's liberation movement have attempted to equalize the roles of women and men in Western societies. This equalization of women's roles has resulted in female crime trends becoming more like those of men (Balkan and Berger, 1980; Adler, 1975). Adler (1975) suggests that it was the development of a "masculine personality" with the concurrent attributes of heightened aggression and competitiveness that was transforming women of the 1960's and 1970's (Balkan and Berger, 1980:216).

These hypotheses, whether accurate or not, were successful in bringing research attention to the topic in an effort to sort through data both in North America and internationally. By comparing national trends in crime and by examining the changing roles of women during the 1960's, criminologists expected to show clear changes occurring in female crime trends if the liberation hypothesis was to stand. Even allowing for the delayed effects of liberation, clear evidence *should* temporally place liberation before any criminal increase occurring after the organization of the women's movement. Unfortunately, merely plotting female crime on a trend line results not in a decisive spike in activity or stepwise change at the expected time but rather what appears to be a slow incremental rise in female crime beginning even before the liberation movement (Austin, 1982). Moreover, a coinciding increase in male criminal activity raises even more questions regarding the causal effect of female liberation and suggests that there may be a gender neutral explanation for the rising female crime rates.

Simon (1976), an early proponent of the liberation hypothesis analyzed forty years of arrest data (1932-1972) for various offenses from the United States to test for changing levels coinciding with the women's movement. These data were used to frame what was perceived as changes in the socioeconomic and political statuses of women. To quantify this "liberation", figures regarding gains in female higher education, females in managerial positions as well as female pay relative to their male counterparts were analyzed. Simon (1976)

concluded that the gender gap was still as pronounced as it had been a quarter century earlier. Thus, attempting to use the status of women as an independent variable became rather tenuous. Still, some gains for women in terms of the percentage engaged in full time employment and female awareness of the disparity of their relative positions were recognized.

In her analysis, Simon (1976) focussed on three time frames: 1953-1972, 1958-1972, and 1967-1972. Coinciding with the purported launch point of the Women's Movement, the third time period was where dramatic change was expected. Based on annual comparison of the increasing proportion of women arrested for all crimes, serious crimes, violent crimes and property crimes, Simon (1976) conceded that there was no great increase in the percentage of women committing violent crime. Rather, the most dramatic increase was found in the proportion of females arrested for property crimes and the most marked increase was for the period beginning in 1967. This finding was viewed as supportive of the hypothesis that:

> [W]omen's participation in selective crimes will increase as their employment opportunities expand and as their interests, desires, and definitions of self shift from a more traditional to a more liberated view. The crimes that are considered most salient for this hypothesis are various types of property, financial, and white-collar crimes. (Simon, 1976: 35)

Remarkably, only one year after Adler's (1975) warning, the tone of the liberation hypothesis had become more subdued and selective in its language. Some evidence of gender convergence had been identified for embezzlement, fraud, larceny (theft) and counterfeiting – but not for violence.

Despite the misleading use of percentage changes in arrest, Simon (1976) successfully identified what were to become the traditional focal points of most research aimed at showing the rise of the new female criminal. Only data highlighting non-violent property crimes consistently produced findings supporting some gender convergence. Whether or not these findings were due to liberation remained largely a matter of speculation. Moreover, the effects of women's liberation on violent crime was flatly dispelled by the recognition from Simon's (1975: 40) vantage point that "...the proportion of females arrested for violent crimes has hardly changed at all over the past thirty years".

The concession that women were making advances solely in petty property crimes was not supported by all research (Austin 1982, 1993; Fox and Hartnagel, 1979; Hartnagel, 1982). Austin (1982) began by challenging the extant research by suggesting that the true point of departure for the Liberation hypothesis should be 1967 or 1968. This decision was reached through the examination of the trends for both female labor force participation and the divorce rate. As an aside, the takeoff in divorce also may be a demographic artifact. If, for instance, marriages tend to break down after three years then we could look at rates of marriage, divorce and crime as being demographically driven. Both series subjectively indicated take off points in 1968 which were interpreted as the time-delayed effects of liberation. From that assertion, it was suggested that convergence was apparent for not only minor property crimes but also for the more masculine crimes of auto theft and *robbery*.

Austin (1982) considered the divorce rate and the rate of female participation in the labor force during the 1960's and 1970's and viewed their trends as being collinear. The criminal data used were those for total female contribution to arrests in both robbery and burglary for the period 1958-1978, and for juvenile and adult female burglary and robbery for 1963-1978 considered separately. Data for larceny-theft, auto theft and fraud-embezzlement by females for 1960-1975, borrowed from Steffensmeier et al. (1979), were revisited. This was done partly in an attempt to demonstrate alternative explanations and to a degree contradictory views regarding the "point of introduction of a change likely to have an increased effect" (Austin, 1982: 414).

By constructing "emancipation ratios"[7] for each of the available years, Austin (1982) asserted that for the crimes of embezzlement and larceny-theft, emancipation (liberation) *was not* causally linked. However, female contributions to robbery and auto theft did appear to be connected to the emancipation of women. The analysis, resting mainly on the visual inspection of trend lines, failed to support the widespread notion that liberation was tied to

[7] "[The emancipation ratio] is used to summarize the difference between the extent of change prior to an emancipation impact and change occurring after an emancipation impact. A ratio greater than one suggests that some particular force, presumably the movement or emancipation, started augmenting female criminality at the takeoff point" (Austin, 1982 :415).

property crime despite the increases in property crime that were readily apparent. This suggested to Austin (1982: 427) that there may be different causal mechanisms increasing female larceny-theft and embezzlement that are acting alongside, but separately, from that which caused the increase in female auto theft and robbery. Unfortunately, Austin (1982) did not explore male crime trends over the same period leaving obvious questions regarding gender differences unanswered.

Austin (1993) undertook an analysis of subsequent data covering the period 1965 to 1986 for males and females. Additionally, population data were included in the analysis to demonstrate the presence of convergence for younger members of the population. This was in response to the suggestion that differences in criminality appear early in life and remain stable over much of the life-course, as presented in the self-control theory (Gottfredson and Hirschi, 1990). Durkheim's (1951) anomie theory provided justification for viewing the disturbance and readjustment of the population through two periods. The series was divided into two periods (1965-1975 and 1975-1986). This would allow the research to show whether the convergence in criminal activity increased more dramatically during the years immediately following the societal change and then slowed in the later period after the initial disturbance and anomic condition had been overcome (Austin, 1993). Through this analysis, prior research indicating no convergence for violent offenses was discounted. Challenging the extensive literature in the area, Austin (1993: 462) stated that:

> [f]indings from the present study comprise grounds for rejecting the dominant position; convergence in arrest rates occurred during at least one period and for at least one age group for violent offenses, masculine offenses, and serious offenses.

Again, despite the acceptance of some degree of convergence for larceny-theft and fraud in the work of Steffensmeier (1978) and others (Simon, 1976; Fox and Hartnagel, 1979; Steffensmeier et al., 1980; Steffensmeier and Steffensmeier, 1980; Hartnagel, 1982; Hartnagel and Mizannudin, 1986), these data suggested

that in fact there was very limited support and even some evidence of divergence for violent crime. Still, Austin (1993: 463) retreated somewhat:

> [noting] that convergence was greater for theft than for personal offenses. At the same time, robbery, which does not necessarily include violence, fell between the theft and violent offenses in the extent of convergence.

These contradictory statements and the unusual categorization of robbery[8] as *not necessarily* including violence effectively reduces the legitimacy of Austin's (1993) findings of convergence for violent offenses, seeming to homogenize these results with the prevailing views regarding empirical support, rather than distinguishing them.

Canadian work on the topic of liberation and criminal convergence using conviction data and more sophisticated analytic techniques have indicated similar trends. Suggesting that changing crime rates for women are a result of changes in the social roles of women, Fox and Hartnagel (1979) analyzed data from 1931-1968 using fertility rates, female labor force participation, and post secondary degree rates for women. A positive effect of these variables on the female crime rates was hypothesized. Both Ordinary Least Squares (OLS) and Generalized Least Squares (GLS) multiple regression analyses indicated that significant increases found for theft only and no convergence support existed for other offenses. Thus, due to the inconsistent effect of the predictors on all female crime generally, inclination towards opportunity or strain hypotheses and away from a liberation rationale was suggested (Merton, 1938; Reckless, 1957; Agnew, 1985). Convergence for minor property crime was identified but the liberation hypothesis was again showing its narrow possibilities for application.

Further research conducted cross-nationally using INTERPOL data indicated that varying levels of female liberation in developed and developing nations showed similar effects on their crime rates (Hartnagel 1982; Hartnagel and Mizannudin, 1986). Hartnagel (1982) anticipated that a higher level of

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[8] It should be noted that this research will ultimately agree with the Austin (1993) insofar as the analysis results for robbery are not entirely consistent with either property or violence but rather appear to indicate robbery behaves as a hybrid of the two crime types.

traditional female role adherence would result in a lower crime rate for women and conversely, increases in modernization and public roles of women would result in a greater proportion of female responsibility for crimes. It further was expected that these effects would not exist for homicide because most homicides are unrelated to property crimes and are "hot blooded". Using zero-order correlations and OLS regression analysis of homicide, larceny, theft, and fraud on the independent variables showed, as expected, no effect on female homicide. Unexpectedly, there were indications that urbanity had negative direct and indirect effects on larceny. GNP significantly affected both fraud and theft. Education was found to be a significant predictor for fraud only.

As an alternative explanation, Hartnagel (1982) posited that the increased availability of goods may be responsible for increases in female theft and larceny (opportunity theory). In addition, the possibility that increased GNP coincides in many cases with social disorganization and the reduction of church and family influence was suggested. Also, it was recognized that there may be some effect of relative deprivation in more prosperous nations where:

> the growth in advertising and consumerism associated with socioeconomic development may produce artificial economic needs that outdistance the shopping resources of many housewives. (Hartnagel, 1982: 488)

It should be understood that these same modernizing influences on female crime as hypothesized should have the same effects on men. The logical commonality of effects between males and females in the above international research was not generally reported. This resulted in making statistical evidence for the liberation hypothesis more likely but less defensible. Frankly, the aim of the liberation theory to show that the new status of women had resulted in increased female criminal activity of all sorts, despite its successes for some crime categories, failed to account conclusively for crime in general. The applicability of the theory to only certain crimes left Hartnagel (1982: 488) to state, foreshadowing Gottfredson and Hirschi's (1990) General Theory, that:

> [A]t least for these types of crime, no special explanation for female crime is required. Rather, perhaps more general, and therefore more parsimonious, non-sex specific explanations may be applicable to both male and female crime. This does not mean that female crime is unimportant, nor does it imply that

> criminology should return to its previous history of virtually ignoring female crime. And it definitely does not imply that female crime should be regarded as at the margin of mainstream theorizing. On the contrary, what appears increasingly to be required is a general explanation for both male and female crime.

Hartnagel and Mizannudin (1986) looked at a cross section of 40 countries using INTERPOL data in an attempt to identify gender-crime convergence as a function of modernization, fertility rate and GNP. Following the earlier research (Hartnagel, 1982), female proportion of arrests was used for the same crime categories as in the earlier study. Averages of the independent indicators and female proportion of arrest over the period 1973-1976 were calculated to improve upon the earlier measures. Similarly modest results were attained in this study with only GNP and urbanity having effects on female fraud whereas GNP alone significantly predicted only larceny. Recognizing the inadequacies of comparing international data due to differing recording practices and resources dedicated to the task, Hartnagel and Mizannudin (1986) suggested that cross-national studies may never be conclusive.

Earlier research suggesting that the use of relative proportion of arrest as the dependent variable prompted a second analysis. Reanalysis was undertaken using the female crime rates per 10,000 as the dependent variable for the crime categories and after transformation of the data to approach normality, the model again lacked explanatory power, prompting the statement "...[t]his line of analysis doesn't seem to offer any encouragement for the theoretical model either" (Hartnagel and Mizannudin, 1986: 9). Later work by Hartnagel and Gibbs Van Brunschot (1994) examined the impact of female economic marginalization on female crime and found limited support for the hypothesis, and only regarding certain property crimes. Importantly though, there was a recognition of the importance for future research comparing the marginality of females *and males* as it pertains to both of their economic situations. Realizing that the common underlying processes may in fact be the same across the genders, credibility is given to the value of determining whether trends are in fact converging (or diverging for that matter) before proposing and testing sex specific crime causality models (Steffensmeier and Harer, 1991).

The liberation hypothesis struggled and did not succeed convincingly in laying the responsibility for female crime trends on the liberation movement. Nationally and internationally, there did seem to be a trend towards greater female criminal activity but the theoretical model received little support and only for limited crime types. A second theoretical model challenged the liberation hypothesis using many of the same ideas but with some modifications. Rather than blaming the women's movement for doing too much too soon, the marginalization hypothesis extended the responsibility for female crime to the continued practical oppression of women in a society claiming gender equality.

Marginalization and Empty Promises

The research environment around the new phenomenon of female crime failed to offer convincing explanatory power when women's liberation was perceived as the causal mechanism. It was hypothesized that there were problems with the basic premises of the earlier model (liberation) in that it was assumed that women had in fact made great advances in their societal positions. This body of research found overwhelmingly that juvenile and adult women were only showing significant increases in crimes traditionally highly represented by women. Steffensmeier and Steffensmeier (1980), using data controlled for age and sex for the years 1965-1977, calculated rates of male and female involvement in crime as well as percentage responsibility for crime. Using thirty arrest categories ranging in severity from *being a runaway* to *murder* with many gradations of property and person crimes included, it was found that there was very little change over the period in question for women generally. Importantly, the only real increases were found in the categories of larceny (shoplifting), liquor law violations and runaways. During that period, only marijuana use and drinking showed appreciable increases relative to males while violent crimes by women remained relatively stable when compared to males (Steffensmeier and Steffensmeier, 1980). This supported similar research conducted by Steffensmeier (1978) suggesting that convergence was apparent for larceny-theft and fraud/embezzlement only, prompting his continued belief that the basis for fearing a new breed of female criminal was misleading.

Moreover, for crimes against the person, the gap between women and men was shown to be widening.

Steffensmeier (1978) suggested that what was actually being experienced by women was not a metamorphosis into a masculinized criminal but rather women were becoming more involved in mostly the traditional female crimes. Also, because false pretenses (bad cheques) and welfare fraud made up a large part of the growing category of fraud, it was surmised that women were compensating for the lackluster advances in financial independence promised to them by the women's movement.

Steffensmeier, Rosenthal and Shehan (1980) examined historical data from the period during and after World War II to assess the changes in female criminality when the number of crime prone males was reduced and female labor force participation was increased. They found that any of the increases realized in female crime rates quickly subsided to their earlier levels after the war. The demographically controlled rates, which were used to compare the data across the series, did show increases in crime for women coinciding with the increase in labour force participation. This would in a sense lead one to proclaim support for the hypothesis. Contrary to the liberation hypothesis, though, increases were virtually non-existent when controls for paternalistic crimes (morals and alcohol) were introduced suggesting that period effects brought on by the social environment may have been accounting for the changes.

Balkan and Berger (1980) similarly found that women have increased their relative participation only for larceny-theft and fraud/embezzlement. They suggest that continued marginalization of women is manifested in the tendency for women to be stuck in lower status occupations. This strain results in "innovation" in property crimes (Merton, 1938; Agnew, 1985; Broidy and Agnew, 1997). Unfortunately, this research failed to provide a complementary test for the effect of male marginalization on male crime. By their interpretation, liberation failed to account for crime primarily because women from the white upper-middle class benefited from the movement and not their lower-class, visible minority counterparts who were more often arrested. Marginalization seemed a much more plausible explanation.

Considering similar issues in the United Kingdom, Box and Hale (1983, 1984) analyzed English and Welsh data to explore the plausibility of the marginalization hypothesis. Their studies addressed both personal and property crimes and found once again that only property crime increases were even partly explained by the use of the traditional liberation measures. Further, Box and Hale (1983) identified and argued that research in the area was plagued by methodological shortcomings, charging:

- failure to control for changing population composition,
- failure to look at male crime trends simultaneously,
- failure to sufficiently dis-aggregate the crime categories,
- inconsistent operationalization of both the independent and dependent variables, and finally
- failure to apply the appropriate statistical tests (i.e. cointegration).

From their analyses, Box and Hale (1983, 1984) suggested that the causative effects of liberation on the criminal behavior of women were at best concurrent and causally ambiguous, and at worst they were dead wrong. Asserting that academic tendencies to equate female labor force participation with liberation were clearly indicative of a middle class delusion, they pointed out the under-employment problem faced by a vast majority of the so-called liberated working women.

The practice of viewing female crime trends without considering the context of male crime trends, as mentioned above, was a recurrent point of contention. In their earlier work, they demonstrated that for all categories of crime studies, the *best predictor of the female crime rate was the male crime rate* for the same offense (Box and Hale, 1983). Similar findings by Steffensmeier and Allan (1990) stressed the importance of using male crime rates as predictors of female crime. They found that the increases in female participation in fraud, larceny and forgery were largely mirrored by similar increases for males. By their interpretation, this indicated that marginalization *of both sexes* may better capture the underlying process of increasing crime trends, rather than merely that of women. Another complication is the correspondingly small increases in female crime, which have been shown to accompany large increases in female marginalization. Furthermore, they depict the typical male *and* female offender as being from a lower socioeconomic and

educational background, being unemployed or under-employed, and being a minority. They state that:

> Overall, the pattern of change has been similar for both sexes, with large increases in arrest rates for offenses like larceny, fraud, driving under the influence, and drug use and actual decreases in some categories like gambling, public drunkenness and vagrancy. Further the typical female and male offenders have not changed over this period: Then, as now, higher proportions of female arrestees were involved in minor property and sex-related offenses, whereas higher proportions of male arrestees were involved in serious property crimes and crimes against the person. (Steffensmeier and Allan, 1990: 94)

Once again, socioeconomic explanations were hailed as the gyroscope causing variations in crime rates in their wake.

In a time series of considerable length, it is expected that there will be historical components which will aid in the interpretation of the data. Because there rarely is access to individual level data over a time series, macrosocial causal inferences most likely provide the best understanding. This methodological premise, together with the desire to explain some of the new phenomenon of rising female crime results in what could be viewed as reductionist hypothesizing. Whether there is a causal link between liberation or marginalization and female crime, the underlying culprit is implied to be economic disparity. Such hypotheses have wide appeal because they are able to explain generalities, but fail when they address specifics regarding criminal activity.

The state of women vis-à-vis the economy is seemingly able to explain why women have *turned* criminal, and why they have been *forced* into crime. Unfortunately for these theories, they are weakly supported by the data and they are unable to explain why only particular crimes have seen increases. The generality of these explanations may at first seem to be their strength, but ultimately may serve as their nemesis. Large classic theories such as anomie and strain are convenient in their simple conceptual elegance. Unfortunately, the operationalization of both concepts is extremely difficult and arbitrary leading to ambiguity in both the early and final stages of research. They are able to explain much of the phenomenon in the eyes of the beholder, but they are lame and arcane from the perspective of the skeptic when hailed as the

complete explanation. Ideally, the strengths of these explanations could be revealed in conjunction with other causes of crime, and not in spite of them. From that point, there can be an attempt at a united model rather than a fruitless paradigmatic collision.

Routine Activities and Criminal Opportunity

Most often, only petty property crime is linked to the changing social positions of women. This creates a problem of generalization for researchers attempting to flesh out the process propelling women towards crime. Critically, this also creates a research environment ready to explain and explore female criminal action as a unique entity, disregarding the possibility that the same process was behind the criminality of both genders. Adler (1975) warned of a general rise in female crime but that was not demonstrated by the data nor has it been since. Perhaps then, there is a need to dispel the notion that women are going to become as violent as men and focus on the reasons why women are found to be participating in property offenses in changing numbers.

Routine activities and opportunity theorists tackled the changing trends in the crime rates. Cohen and Felson (1979) suggested that the increase in crime being witnessed in the period (1947-1974) could be explained by new lifestyle and employment changes that had occurred. Increased accumulation of portable consumer goods (suitable targets), likely offenders (the poor and unemployed) and the absence of capable guardians (dual income households) were keys in explaining the increase in property offenses. While showing some statistical connection between social and economic conditions, the conclusion that increasing predatory crime rates "may not simply be an indicator of social breakdown, [but rather] a byproduct of freedom and prosperity as they manifest themselves in the routine activities of everyday life" seems commonsensical and parsimonious (Cohen and Felson, 1979: 605).

Later, Cantor and Land (1985) studied the unemployment rate as a macro-social cause of the crime rate. Debating the actual directional effect of post World War II unemployment rate activity on crime, they posited that popular understandings of the process were erroneous. They suggested that periods of high unemployment, at the aggregate level showed contemporaneous

decreases in crime because of three factors: increased guardianship of homes, decreased movement of the population outside their homes, and the ability of social welfare programs to minimize hardship in the short run following job loss (Cantor and Land, 1985: 319). The implication for the study of changes in female crime is basically that since the last fifty year period has seen women increasingly working outside the home in addition to maintaining their traditional roles as primary day-to-day purchaser for the family, increasing female crime should not be unexpected. Opportunities for embezzlement, theft and fraud logically follow increased employment and consumerism. The economic argument has similarly been explored by many sociologists and economists who have found, in general, a relationship between unemployment and crime despite the differing importance placed on the relationship with respect to the various theoretical models utilized (examples can be found in Box and Hale, 1983; 1984; Cohen and Land, 1987; Naffine and Gale, 1989; Hale and Sabbagh, 1991; Schissel, 1992; Reilly and Witt, 1992; Pyle and Deadman, 1994; Macmillan, 1995; and Hartnagel, 1998).

Contributions by Steffensmeier, Allan and Streifel (1989) looked cross-nationally at 69 countries using INTERPOL data on female proportion of arrest for minor and major property offenses as well as homicide. They explored the predictive power of opportunity for female property crime, formalization of social control, gender equality and economic marginality of women. Again, their findings indicated the availability of suitable targets (rate of portable consumer goods per 100,000 population) accounted for most of the explained variance. No support for marginalization or liberation was found with only slight evidence showing a link between technological modernization and female proportion of arrest for minor property crime.

Cross-sectionally, an opportunity perspective seems compelling but there are problems when this argument is made to explain the variation in crime over time. Perhaps in the developing world increasing wealth of the population does succeed in presenting increased opportunities for theft and increased incentive for other types of property crime. Problems arise when violent crime is addressed from this perspective. Moreover the declining crime rate in the developed world cannot be explained. Arguably there are more portable and

expensive consumer goods today than in any point in the past leaving one to wonder what may cause the decline that is being witnessed. It is plausible that increasingly vigilant surveillance by merchants can account for a deterrent effect resulting in some of the decline in arrests. If deterrence is not counterbalancing the effects of increased opportunity, one would also expect a larger number of arrests to result from the high technology monitoring of consumer outlets and private homes. While opportunity rationales are effective when explaining linear changes in crime, they offer little in the way of symmetrical crime trend explanations (Cohen and Land, 1987). Bluntly, they are only able to explain a trend until it changes direction.

New Approaches to Old Questions

The study of crime trends tends to focus on the differences between naturally occurring dichotomies such as youth versus adult, male versus female and increases versus decreases. This research is not entirely different in that the available aggregate data distinguish between juvenile and adult offenders of both genders. The thirty-six year series (1962-1997) provides a sizeable number of data points from which the increases and decreases over time, both within and across groups, can be revealed. Furthermore, the offenses taken individually (i.e. "theft under") or as categories (i.e. "total property offenses") allow freedom to revisit many of the disputes present in the literature.

Crime studies can be loosely categorized according to a few major schools of thought. Age serves as a predictor in all crime data. The propensity toward crime for younger adults and the invariability (within reasonable limits) of the age-crime curve are easily substantiated in all societies and for all crime types. There are differences between age-crime curves for the different offenses but the pattern of rise and decline holds for most types of crime within the same general categories. Gender is an important factor for several reasons. The traditional and continuing disparity between male and female crime rates leads one to wonder what differences exist between the criminality of the sexes. From this, discussion leads to the differences between male and female crime trends. In answer to the suggestion of general convergence, either for reasons of

liberation, marginalization or other differences in the female situation over the period in question, these data lend themselves well to ascertaining the extent of the change over time. Routine activity explanations can also be explored through the addition of female employment data to the crime data. These employment figures, serving as proxies for the general economic climate, can shed some light on both male and female crime rate changes.

Methodologically, there are a number of options for this research. One could replicate existing methods using the longer time series and presumably the advantage would be the ability to assess the impact of the additional data on the earlier results. It is also possible that the same research questions could be asked with innovations in the method of operationalization of the key variables. Traditional methods of hypothesis testing could be employed with the use of forms of Ordinary Least Square (OLS) regression adjusted in a number of ways to minimize the serial correlations present in time series. These techniques frequently are criticized for promoting high levels of false positives (Ostrom, 1990: 36) as well as spurious results (Phillips, 1986; and Pindyck and Rubinfeld, 1991: 465). The use of alternative statistical techniques employed in economics, particularly for non-stationary series, provides the opportunity to address some of the questions posed in the research from a different direction. Economists have a long tradition of time series analysis due to a preoccupation with long term trends in markets and economic growth.

Rather than rejecting or failing to reject a hypothesis of convergence on a particular dependent variable based on causally ambiguous increases relative to another trend, a test for cointegration is arguably a better way to begin. The test, which will be explained in detail later, indicates whether there is any reason to believe that individual time series are converging or diverging. If the test indicates that cointegration is occurring, there is no reason to believe that changes in the relative positions of the series over time are significantly different from zero. Ostensibly, the series are in a long run equilibrium (Charemza and Deadman, 1997). If the series prove *not* to be cointegrated, there is reason to accept the notion that some relative difference exists between the multiple series. If cointegration has been established, it is still possible to explain short-term differences in the individual series using regression based on

the theoretically relevant independent variables (Brannigan and Lin, 1999). The advantage of this procedure is the removal of the initial doubts regarding the existence of gender convergence and the ability to move beyond that stumbling block. Cointegration provides confirmation of a *common underlying process* but does not necessarily reveal the components of that process. It is also attractive because it permits the researcher to explore short term effects in a series in addition to long run equilibrium relationships.

The following chapter will outline several components of this research, including the data assembly and the methodology employed.

1. The data sources will be detailed to give an understanding of the process of creating the time series under study.
2. A detailed discussion will be given of the methods which will be employed in the analysis section of the thesis including justifications for the use of cointegration and error correction techniques. In addition, there will be some explanation of more basic, yet crucial aspects of time series analysis in general.
3. Unemployment will be explored as an explanation for crime rate changes over time. Again, this inclusion is not new but the method used to explore the relationship between the phenomena of crime and unemployment may provide new interpretative options. Both age structure and unemployment appear throughout the literature as explanatory variables. The Easterlin Hypothesis (Easterlin, 1978; 1987) suggests they should be considered as interrelated and inseparable. This rationale will be explored in greater detail in a later chapter.
4. Demographic structure will be explored and arguments will be made for the utility of the age structure of a population in explaining changes in crime levels over the time series. Population figures for each age (12-39) and both sexes will be used to reassert the importance of including the age-crime relationship in a time series analysis. Based on figures reported by Statistics Canada, attention will be paid not only to the traditionally held relationship but challenges will also be leveled at conventional understandings of the invariance of the pattern of crime across age groups.

For the sake of convenience, an extensive (although not exhaustive) annotated bibliography (Appendix A) reviews and briefly summarizes the literature on the effects of gender, age, social controls, demography and unemployment on crime. The research summary lists the research in alphabetical order (by surname of lead author) and covers most of the empirical literature reviewed for this thesis in the area of general crime, liberation, marginalization, routine activities, strain and the Easterlin hypothesis (including both demographic and unemployment explanations of crime).

Chapter 2: Data, Methods and Variable Selection

Data Assembly

The data for this research originated from many sources and were largely the result of the amalgamation of multiple series from various data sets directly or indirectly connected with Statistics Canada. Because of the length of the time series (1962-1997), there are practical reasons why the data did not exist in a comprehensive set. One reason for the partial or truncated data maintenance may be the limits on publication space necessitated by long, complex trends, although most series could be made available in electronic form. Also, the existence of a series spanning twenty or more years often makes little sense insofar as the phenomenon being measured can change to such an extent that comparisons over extended periods become nonsensical. Furthermore, and perhaps more captivating, is the suggestion that these measures of crime over time are irrelevant due to the individual and personal nature of criminality. By this, I mean that there are arguments in criminology which remove the individual from the aggregate and suggest that changes in overall crime are the result of individual changes in the criminals. The social milieu is not as important or interesting because crime is not *caused* there, it is caused by individual criminal propensities and crime merely *occurs* in society.

This is not to say that criminology does not concern itself with how much crime exists in society at a given time or over the previous few years, but often it is of secondary importance. Rather, studies of "individual" criminality thrive on the availability of longitudinal (i.e. "life course") data tracking identifiable persons over considerable periods. Arguably, this method of analysis offers much in the way of validity. Some large longitudinal studies have had the ability to follow subjects through their early adolescent period when initial indications of criminality or deviant behavior were barely showing themselves. The tracking and revisiting of the subjects over the course of many years allows for an understanding of criminal onset phases, peak criminal ages, experiences with the criminal justice system and the gradual and expected retreat from criminal activity (Blumstein, Cohen and Farrington, 1988; Sampson and Laub, 1993).

The use of aggregate crime data allows for analyses different from those suggested above but at the same time exposes the research to different limitations. The recognition of these concerns is routine in the literature. There are no remedies for them but merely justifications and attempts at showing the utility of time series data for addressing otherwise inaccessible questions.

The Patchwork Data Set

Upon deciding that the most effective treatment of an empirical problem requires the use of time series data, many method-specific issues immediately arise. Of course, much concern regarding variable selection and operationalization can be resolved through the use of informed theoretical reasoning and literature reviews. Still, compromises must be made to establish the logical limits of the data and reconcile those limits with the previous research of the subject matter. Despite the fact that a shorter data set is often more readily available for use, the desire to advance the research by posing further questions and employing new techniques often necessitates the extension of the time series. That being said, there is a conceivable point of diminishing returns where the extension of the data a slight amount may involve great effort for presumably little gain. The determination of an acceptable length for a time series depends both on the substantive area and the method of analysis.

The data for Canadian criminal charges were easily available for the period 1977-1995 through an electronic source. By some standards, a nineteen-year series would have ranked as quite acceptable based on the previous literature (Reilly and Witt, 1992; Pyle and Deadman, 1994). This source, CCJS Quickstat, is a machine readable data file distributed by Statistics Canada and the Canadian Center for Justice Statistics (CCJS). This file contains the common offenses for Canada and the provinces by sex and age (i.e. adult / youth) with some of the categories based on a summation of related offenses. "Theft" for instance was made up of "theft over", "theft under" and "motor vehicle theft" and would be acceptable if one was not concerned with finer distinctions between the individual offenses. For most of the offenses,

there were acceptable specific crime values but for some, comparisons across other published sources were required. Again, using theft as an example, to

TABLE 2.1: DATA SOURCES*

***RATES OF OFFENSE AS WELL AS UNEMPLOYMENT RATES ARE PROVIDED AS APPENDIX B.**

OFFENSE[9]	PERIOD	FORM	REFERENCE (SOURCE)
HOMICIDE, ATTEMPTED HOMICIDE, ASSAULT, ROBBERY, BREAK AND ENTER, FRAUD, THEFT UNDER, THEFT OVER, MOTOR VEHICLE THEFT.	1962-1985	Data File	Relative Trends CCJS © 1986
{AS ABOVE}	1977-1995	Data File	CCJS Quickstat © 1996 (Note: Some data were extracted from Annual Catalogues #85-205. Also, a special request from CCJS was made for *gender specific* youth crime for the period 1987-1991)
{AS ABOVE}	1996-1997	Publication	Catalogue # 85-205 Annual
THEFT INDEX[10]	1962-1985 1986-1997	Data File Publication	Relative Trends CCJS © 1986 Catalogue # 85-205 Annual
VIOLENCE INDEX[11]	1962-1985 1986-1997	Data File Publication	Relative Trends CCJS © 1986 Catalogue # 85-205 Annual
PROPERTY INDEX	1962-1985 1986-1997	Data File Publication	Relative Trends CCJS © 1986 Catalogue # 85-205 Annual
UNEMPLOYMENT RATES			
MALES AGED 15 AND OVER	1962-1975 1976-1997	Publication CANSIM File	HSC[12] ©1983 Series Label D234 CANSIM Series label D984970
FEMALES AGED 15 AND OVER	1962-1975 1976-1997	Publication CANSIM File	HSC ©1983 Series Label D235 CANSIM Series label D984986
UNEMPLOYMENT BOTH SEXES AGED 15 AND OVER	1962-1976 1977-1997	Publication CANSIM File	HSC ©1983 Series Label D233 CANSIM Series label D984954
POPULATION DATA			
MALES TOTAL FEMALES TOTAL	1962-1970 1971-1997	CANSIM File CANSIM File	CANSIM Matrix # 06430 CANSIM Matrix # 06367
BY SPECIFIC AGE MALE AND FEMALE	1962-1970 1971-1997	CANSIM File CANSIM File	CANSIM Matrix # 06430 CANSIM Matrix # 06367

[9] Data for each of the offenses were recorded by the gender and age (i.e. youth/adult) of the offender.
[10] A theft index (including theft over, theft under, and motor vehicle theft) existed in the Quickstat Data File and it was assembled using the same criteria for both the earlier period (1962-1977) and the later period (1995-1997) for the sake of uniformity and completeness.
[11] The annual crime reports include a summative count of "all violent crimes" and "all property crimes". These crime categories were calculated for all other years) to complete the series.
"All Property Crimes" include break and enter, motor vehicle theft, theft over, theft under, possession of stolen property and fraud.
"All Violent Crimes" include homicide, attempted homicide, sexual assault, non-sexual assault, other sexual offenses, robbery, abduction and kidnapping.
[12] Historical Statistics of Canada

determine the involvement of adult females in "theft-under", it became necessary to refer to the Canadian Crime Statistics Catalogues (85-205 Annuals) which are published by Statistics Canada and present the data for each Uniform Crime Reports (UCR) offense and category. These catalogues provided an opportunity to both extract data and also cross-reference sources to ensure the validity of the data set.

Another concern during the research process was the varying format of the government publications over the course of the time series. The values for youth offenses, as mentioned earlier, were reported by sex for all of the series available in the CCJS Quickstat Data File but the exact numbers for particular offenses were not listed due to the use of the summative indexes that were created for this data file. Upon examination of the Canadian Crime Catalogues for the period 1977-1995, it was noticed that there were five years (1987-1991) which reported the offenses of "young males" and "young females" as "total youths charged"[13]. All prior and subsequent volumes provided the necessary separate information on juvenile males and females but the gap needed to be remedied. Fortunately, the decision to report the data in this new format was not the result of different recording practices by the police forces across Canada, but rather was a decision made at the dissemination stage. Thus, the values were available for a fee by contacting the CCJS and requesting a special distribution of the missing annual tables.

Initially, the effort of locating, accessing, and joining the data together seemed daunting. Before lamenting, one need only consider the alternative of collecting a sample of the national crime data through some method of random sampling of police forces, gaining permission and access, travelling, recording values, analyzing and inferring results to the larger population. Suddenly the process of troubleshooting a complete, although sometimes elusive, data series becomes optimal. Still, because the information collected was often woven together using two or more series, a detailed table of the data and sources is provided (table 2.1). It is worth mentioning that in all cases, the data sources provided overlapping figures for several years which allowed the data to be vetted for accuracy.

All of the tabulated data were reported in numbers of offenses cleared by charge (by sex and age) for the entire country. The data are more informative, it is argued, if one uses rates to portray change over time because of the ever-changing population figures. Controls for population change were introduced into the data through the use of actual population figures by sex for each year of the series (with inter-censal estimates). Annual crime rates were calculated by gender using the usual method:

$$Rate = \frac{Offense}{Population} \times 10{,}000$$

where *offense* is the total for a specific offense or category of offenses and *population* is the total number of persons of that gender alive in the given year. Because the actual numbers of offenses for some of the specific rates was low resulting in very small values in the numerator, it was decided that a rate per 10,000 would provide more interpretable rates.

The population figures were divided by sex to improve the accuracy of the rate calculation. Rather than use total population as the denominator, the use of gender specific population figures controls for variability in the numbers of males and females in the population. Also, the sources for unemployment rates are listed in table 2.1 and brief definitions of the rates are included. Statistics Canada has maintained these rates for many decades, so no alterations were needed or advisable. Also, it should be recalled that the gender specific rates have built in changes in labour force participation across the genders because the definition of "unemployment" means being out of work as well as actually seeking employment. This will become more relevant later when justifying the use of unemployment over options like labour force participation.

Limitations of Aggregate Secondary Data

From a methodological perspective, there are several concerns which are routinely appended to the use of aggregate crime figures. Moreover, the use of these figures over a long time series requires that one accept the failings of the

[13] Catalogue # 85-205 (1987-1991)

data for each individual year as well as any idiosyncratic variations in the data collection process over the entire period. This point cannot be disputed as it pertains to this research. Researchers have noted, and continue to struggle with the theoretical and technical considerations associated with this type of data and the analysis thereof (Kitsuse and Cicourel, 1963; Charemza and Deadman, 1997: 92). Nettler (1974), by dedicating an entire chapter to the issues regarding aggregate crime data, emphasizes the need for caution. The general warning for researchers and the public is,

> [t]he more the records used as measures of crime are 'socially processed', the less accurate they are as indicators of all criminal acts. This source of distortion affects in various degrees all attempts to count crime and leads to another criminological *'axiom':* every measure of crime for an aggregate of individuals probably *underestimates* its actual count. This would not be an obstacle to understanding crime causation if the underreporting were random or systematically biased in some known manner. However, if the difference between crimes committed and crimes recorded is biased in some *unknown* way, then many competing explanations can claim to be plausible (Nettler, 1974: 43-44).

Still, the type of research being undertaken necessitates the use of a particular type of data. Longitudinal data are difficult and expensive to acquire and would require the use of measures determined by others much earlier — therefore potentially limiting the research possibilities. Single wave or irregular cross-sectional data are usually rich in detail but provide only a snapshot of the phenomenon, which is insufficient for time-series studies. Similarly, self-report and victimization data are potentially very rich in detail but generally do not span a sufficient amount of time or maintain uniformity to the extent that long-term trend analysis requires.

Compromise in research is a constant. One can only wish all questions could be asked, all variables controlled, all models tested and all biases rectified. Regardless of the source of the data, crime or otherwise, there are always imperfections whether the data are collected personally or by a government agency. This is merely one burden of research and proceeding by faith alone is not sufficient, but rather informed acceptance of the limitations of the data sources is the best one can do. Specifically, the issues regarding crime data are (a) what are counted as criminal acts? (and what are not?), (b) who

counts the offenses?, (c) what external factors exist which can change the amount of crime? and (d) how are the numbers manipulated?

Depending on the research question, the use of "police contact" data, arrest data, conviction data, victimization reports or self reports may be used (Visher, 1983). In this undertaking, the use of arrest data was selected for their availability and their inclusion of only those incidents proven to be *founded* after a police investigation. The use of police contact data would include *founded* and *unfounded* allegations and potentially interesting details, but these are difficult to acquire because of the lack of formal paperwork which accompanies some unofficial contacts. Also, a considerable proportion of the allegations investigated are determined to be unfounded. Conviction data also have implicit restrictions. They would eliminate those incidents where there was no conviction and also contain only conviction details, and not the actual charges. When one considers plea bargains and the conviction of offenders on lesser charges, the seriousness of this compromise becomes clear. For the reasons mentioned earlier, the use of self report and victimization data is unacceptable for many analyses of long term aggregate crime trends.

The use of arrest data, as has been selected here, eliminates some of the above concerns while introducing additional matters. The foremost advantages of the use of arrest data are the age and gender distinctions made in the recording of incidents. Because of the method of accounting used by the police, only the most serious charge in an incident is reported. As a result, there can clearly be an under-reporting of less serious crimes when they occur in conjunction with a more serious crime. Consider a scenario where a shoplifting attempt is witnessed by a lone store clerk who intervenes only to be subsequently badly beaten, stabbed and robbed along with two other shoppers. Many criminal acts are committed in a very short time period. In the US and Canada, the recording of the "most serious offense" would result in either an armed robbery or an aggravated assault count being recorded. Depending on the decisions of the police and the prosecuting attorney, the most serious (measured by that with the most severe penalty) will be recorded and all others will not be recorded in the Uniform Crime Reports. It becomes clear that many crimes are "lost" at this stage (Nettler, 1974).

Upon closer examination, many crimes are harder to categorize than we commonly acknowledge. The officer receiving a complaint is left to determine whether a street robbery falls under the heading robbery, assault or theft. Many factors come into play to make this determination. Visher (1983) points out, based on street level observation research conducted with US police forces, that certain themes were uncovered regarding the decision making processes of the police. It was found that police tended to rely on seriousness of the offense, the location, victim characteristics, offender characteristics and the subjectively perceived relative statuses of the victim and the offender. Briefly, her conclusions were that the likelihood of arrest and the level of police intervention increased with the seriousness of the offense. Also, males were more likely to be arrested than females. If the offense took place in public, the victim desired police action, the offender exhibited a disrespectful demeanor and the victim was from a higher social status than that of the perpetrator, more serious processing of the incident was likely. Much of the research on police owes a debt to the early pioneering work of Black and Reiss (1970). Clearly, the above list of subjectively defined offense-offender-victim characteristics identifies the possibility of inconsistent response and recording practices among officers and police forces. Also, depending on the personal 'mood' of an officer, differences may exist from one time to the next for the same person (Reiss, 1971).

The environment in which officers' work can also play a role in what is focussed on at a particular time. To illustrate, the public's moral outrage over the use of child pornography over the internet may become strong enough to compel police forces to dedicate greater resources to the detection of such activity, thus increasing the arrests for such activities. In this sense the police are dispatched to answer the cries of the public when problems become "hot". With limited resources, there are compromises made by the police involving the redistribution of human resources leaving less policing in some areas while increasing policing in others. A second illustration of an external influence can be found in the Young Offenders Act (YOA) in Canada. From its 1984 enactment, the YOA has undoubtedly affected the trends in juvenile crime. Some would argue that the lenient nature of the YOA caused juvenile crime to

increase because fear of punishment was reduced. Others would suggest that the increases witnessed in juvenile crimes are the result of police being more willing to process young offenders because penalties were lessened and the punishments were considered to be good "wake up calls", rather than merely punitive. The truth may lie somewhere between these possible explanations but exactly where can never be known on the basis of the official statistics alone.

The fourth issue of note is the manipulation and presentation of numbers and the ambiguity that can be raised using different methods of presentation. In this research, the warning is moot because the data being used began as recorded frequencies for all of Canada and any manipulation thereafter occurred as part of this analysis. The manipulations that did occur are made explicit but they are rarely more complex than rates.

On a more encouraging note, there are some good reasons to believe that data collected over long periods of time are reasonably stable in the types and amounts of error variation that they contain (Stark et al., 1983). Also, some comparisons of results using different sources of data suggest that even for crime, the magnitude of the absolute figures can not be relied upon, but the relative magnitudes are acceptable. This increases our confidence in reliance upon official statistics while also making a good argument for the use of many types of data. Nettler (1974: 44) states that, "these different measures point toward similar zones of crime causation, and ... this result allows a reasoned choice ... among explanations of crime".

The Ecological Fallacy

Interpreting the results produced by aggregate data analysis has specific associated concerns. There is a temptation to take aggregate data and make inferences based on the combination of these data. Unfortunately, data collected at this level cannot be traced back to an individual person. When the data for criminal incidents are collected, the police obviously know who they are counting and a record is kept of that information. Should the police wish to conduct research based on their data they can do so having at their disposal the information regarding the nature of the offenses, the background of the offender and the victim in addition to the outcome of the arrest. When a federal

agency like Statistics Canada or its equivalent takes the reduced data from each policing agency to add to the national totals, it generally consists of only a count of the most serious offenses by the age and sex of the offender.

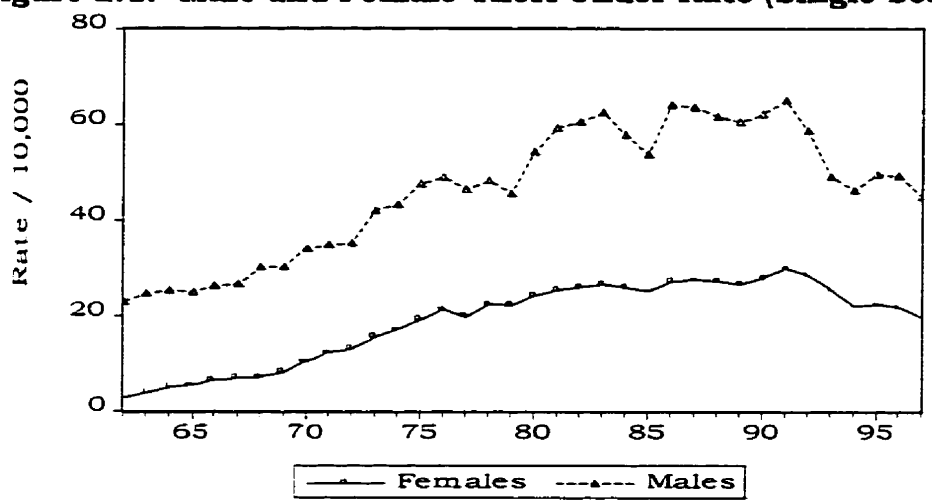
Should a researcher take these crime data and enter them into an analysis in conjunction with other aggregate data, such as income levels of the population, unemployment rates and educational attainment of the population? We recognize this is common as our review of the literature suggests but it is potentially problematic. The problem is that the interpretation derived from the analysis may be flawed due to the ecological fallacy. The causal mechanisms identified in any analysis done this way are not easily verifiable because there is no way of knowing whether those persons with particular characteristics (i.e. unemployment or low income) are the same people causing the crime rates to fluctuate. Particular theoretical beliefs may suggest certain relationships exist but often nothing more certain than contemporaneity of the trends can be asserted. Still, aggregate trends can be studied over time to identify co-mingling phenomenon and make claims regarding their apparent interrelationships short of causality. The warnings that precede this research could suggest that such an undertaking is highly problematic. Certainly, without an understanding of these issues, the interpretation of the findings would be naive. Still, with certain questions regarding long term trends, including comparisons across the sexes, there are compelling reasons for believing that the crime that is recorded has sufficient validity to proceed. Also, we believe that the truth will be revealed only when the research community is able to assemble the results of different contributors and draw conclusions which go beyond the limitations of each separate contribution. The following section demonstrates the trends which exist in the data for various offenses. A certain amount of "faith" in the data is created by the uncanny similarities in the trends. There is no pretense of perfection in the accuracy of the crime accounting, the population figures or the unemployment figures. The similarity of the trends for both genders across so many variables is suggestive, at least, that the errors were made equally for both men and women over the series. Furthermore, data of this kind are valuable when used properly and serve certain purposes extremely well. Upon justification of the use of aggregate data,

it becomes necessary to select the specific aggregate to use as the sample for the whole population. For our purposes, the data as collected are believed to be the best available for understanding the long term trends in Canadian crime.

Inspecting the Data for Common Signatures

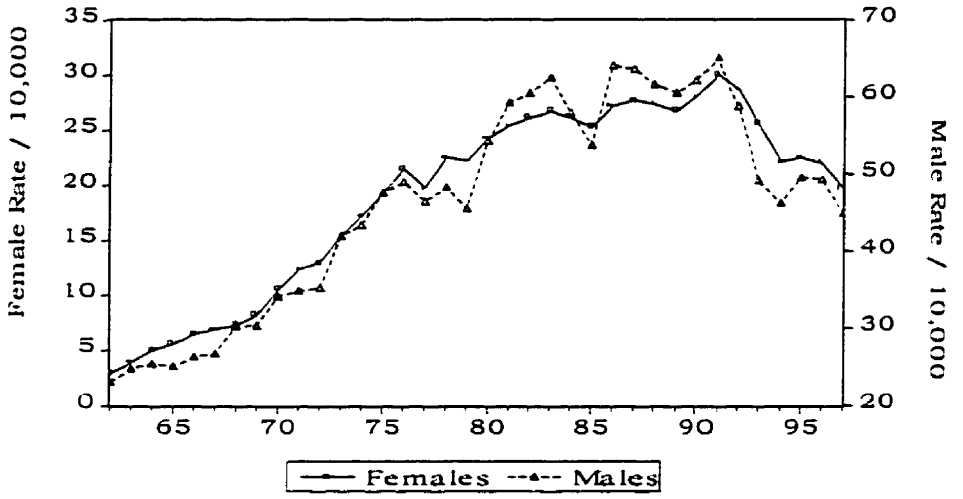
Each series possesses characteristics which make it distinct from others. Despite the general similarities between two trends, perfect duplication of two independent series is rare. If one relied on exact copies across two or more series before drawing conclusions (like comparing two fingerprints) there would be little to report. Observations are more compelling if the comparison of several series is approached more like the analysis of various samples of handwriting. As mentioned earlier, there are specific short-term variations in all series. Also, there are general patterns that emerge over a sufficiently long series, which can be easily identified. These involve long term swings in the series, which become particularly interesting when the same general fluctuations are apparent over several series. Today, the technology available allows for visualization of series through virtually instant production of many types of graphs. These advances make it possible to plot data on the axes and view change over time easily. To demonstrate this point notice the line graph of male and female theft-under rates for 1962-1997 (figure 2.1).

Figure 2.1: Male and Female Theft Under Rate (Single Scale)



Although impressive, the implication of this graph is that male and female rates for this offense are not particularly interesting when viewed together because of the huge disparity in absolute rates. Conversely, upon examining the next exhibit (figure 2.2), it is clear that some relationship between the two trend lines likely exists.

Figure 2.2: Male and Female Theft Under Rate (Dual Scale)



Realizing that the two figures are presenting exactly the same data, the advantages of graphical software for producing multiple scale graphs is obvious. Both types of displays have their purpose but to study "signatures", or general tendencies, between phenomenon differing greatly in magnitude, the "double-Y" graph is far superior. The double-y transforms the data into z-scores and plots the graphs with means at the same y location but preserving the different scales of dispersion.

Methodology

The use of time series analysis has been applied to data in many disciplines. Because such series are frequently non-stationary (i.e. unpredictable, random walks), their meaning (or significance or underlying logic) and the strengths of association between them is inherently difficult to make sense of. Economists who continue to rely heavily on the use of data

available over long terms, in large part due to cyclical assumptions in economic theories, have pioneered new approaches. The maxim "necessity is the mother of invention" is evident in the flurry of econometric techniques devised to deal with aggregate time series data and problems of serial correlation in such data. Many volumes focussing on these techniques have been produced with each innovation, refinement and debate (Engle and Granger, 1991; Mills, 1990; Kennedy, 1993; Cromwell, Labys and Terraza, 1994; Cromwell Hannan, Labys and Terraza, 1994; Charemza and Deadman, 1997).

Serial correlation and nonstationarity are serious problems with time series data[14]. Basically, serial correlation suggests that a variable's value through time is in part a function of the preceding values. Thus, statistical models are faced with not only determining the effects of the independent variables but also the confounding effect of the momentum of the dependent variable through time. Statistically, the problem is that the error terms are correlated with the means in the same series contrary to the assumption of OLS regression — and that the observations are not selected randomly but serially. Substantively, the phenomenon suggests that there is an inertia in the series by which the best predictor of the next value is the previous value, pointing to a common dynamic. Several methods have been proposed to deal with this problem. The early use of simple OLS regression was misleading because inflated Students-t statistics are often produced as a result of the underestimated standard errors (Kennedy, 1992: 247). Alarming examples provided by econometricians suggest that "false positives" can be produced when in fact no relationship between the variables exists (Pindyck and Rubinfeld; 1998: 89). Engle and Granger (1987) note the possibility of a model producing very impressive R^2 values and significant regression coefficients (*b*'s) where the only relationship is the correlation between the error process and the observations. Charemza and Deadman (1997: 93) suggest that scenarios where these high R^2 and significant b-statistics can look very interesting indeed. They warn that should researchers "forget" to report the Durbin Watson (D-W) test

[14] serial correlation has a parallel in geographic analysis where 'contiguous' spatial units share similar features and experience diffusion or effects across the units.

statistic for serial correlation, a totally spurious relationship can appear to be extremely impressive. By way of example, Steffensmeier et al. (1992) simply failed to report t-values for their regression because the standard-error values were "inflated" and cited instead the changing R^2 across a series of what were obviously non-significant models. More specialized procedures such as autoregressive AR(1) models which in Hendry's (1991: 57) words, act to "mop up" serial correlation problems have been developed. Cochrane-Orcutt estimates model the serial correlation as "rho" – a coefficient which has no substantive interpretation, then include the exogenous variables in equations where the R^2 is already approaching unity (Macmillan, 1995: 67). Still, researchers are advised to use "very conservative" significance levels to prevent misleading inferences and the reporting of results of totally spurious regressions (Ostrom, 1990: 36). Despite attempts at refining the autoregressive procedures, Mizon's (1995) analysis of the potential for false results and the general invalidity of the method prompts the admonition of those researchers attempting to correct the problem through the existing AR(1) methods.

Cointegration analysis has been used since the mid 1980's and has been developed to the point where other disciplines have begun to take notice of the power it has for interpreting the long and short run dynamics of multiple time series. Charemza and Deadman (1997: 84) state:

> [Cointegration analysis] has been regarded by many econometricians as the most important recent development in empirical modeling. The basic computational ideas of applied cointegration analysis are simple to understand and to use, as they require only the application of the method of ordinary least squares. The theory behind the computations is not so straightforward.

Because ordinary least squares (OLS) regression is widely used in many disciplines for data analysis, the method is accessible to most empirically oriented scholars. The theory and the development of the process are highly technical and complicated. Fortunately, to benefit from cointegration analytic outputs, researchers need only understand that data preparation and inspection at the outset of the analysis are sufficient to instill confidence in the results produced. Of course, an understanding of the correct interpretations of

the results is also necessary but the specific computerized calculations can largely be trusted as being transparent.

The benefit of a cointegration analysis is the ability to determine if there is a long run relationship between two or more series of data. If such a relationship exists, a related procedure known as an error correction mechanism (ECM) allows for the further inclusion of variables to explain short run variation in the relationship based on the explanatory power of other exogenous variables. This coupling of the above techniques provides for a model able to explain the *long run equilibrium* between series in addition to the *dynamic short-term fluctuations* to improve the explanatory power of the model. Without the ECM, the analysis would be limited to a test for the presence or absence of a cointegrating vector. With an ECM, information about the nature of the long run relationship between the two series can be combined with other variables to model short and long term effects. The following sections will provide explanations of the preparatory steps prior to undertaking a cointegration analysis. These steps include: (a) visual inspection of the multiple series, (b) testing each series for stationarity and (c) determining the order of integration.

Visualizing a Trend

As was noted earlier, the ability to view the shape of a trend over time in graphical form provides the researcher with clues about relationships, which are obscured by a table of numbers. The magnitude differences of the values and the similarities between the physical shape of a series can be *controlled* through the use of the "double-y" graphing technique. Although skeptics may claim that the use of dual scaled graphs for series can distort relationships and create interest where none really exists, it can be argued that failing to use such a technique can also obscure interesting relationships (refer back to figure 2.1 and figure 2.2). Therefore, dual scale graphs are used throughout this analysis to detect common patterns or common signatures of crime across the genders. The consistent *under performance* of females in crime would produce line graphs indicating little of interest other than the continued gender-crime

disparity. But, the presentation of both trends superimposed on one graph, each with an individual scale, offers much more information.

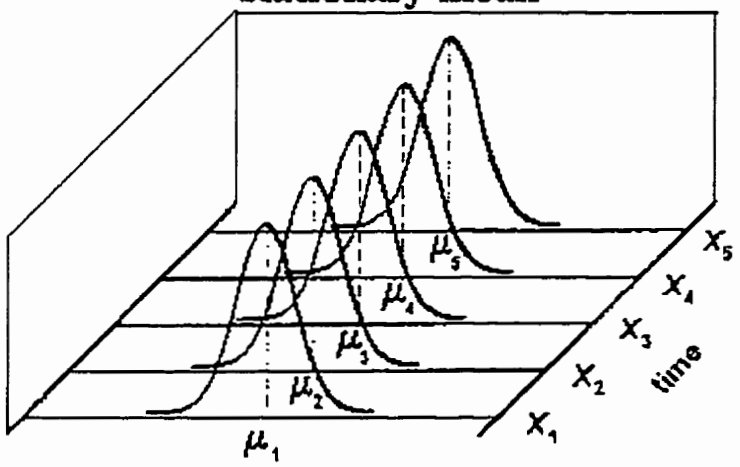
As the initial step in the analysis of possibly cointegrated series, the visual inspection can provide justification to continue or terminate the analysis. As mentioned earlier, the series need not be identical to prompt such an analysis. Merely possessing similarities in their shape is enough to warrant further analysis. Clearly, not every series will be cointegrated despite a promising visual inspection. There are some series which seem to be likely candidates for cointegration yet fail because the requirements of the test for cointegration are very stringent.

Stochastic Processes and Stationarity

An understanding of stochastic processes is necessary before diagnosing series effectively. Time series analysis takes the position that the stochastic process (randomness) of a series can be modeled and described. In other words, " a time-series model provides a description of the random nature of the stochastic process that generated the sample of observations under study" (Pindyck and Rubinfeld, 1998: 489). The same explanation given below applies equally well to the estimates themselves but because of the focus on error terms later, explanation of stochastic movements will be framed in the context of residual series. The series of errors, upon analysis, are determined to possess a stochastic process of some kind. The process can be stationary or non-stationary (with some sub-types of non-stationarity). To assess what type of process exists, the means, variances and covariances of the error terms are studied to determine if they are constant over different points in time. Figures 2.3 and 2.4 present graphically the point being made.

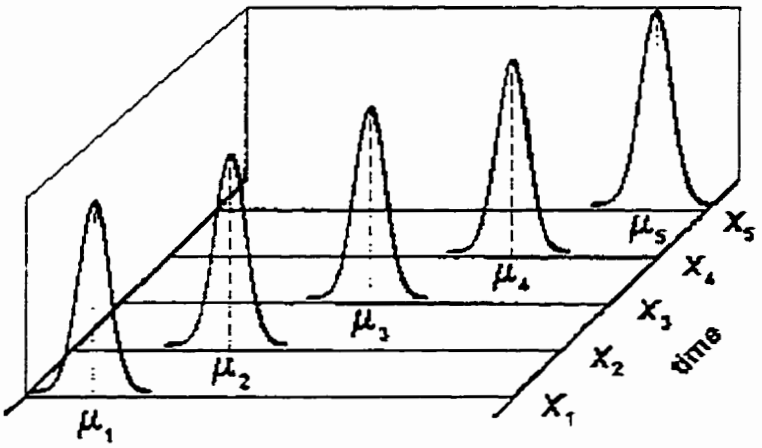
In figure 2.3, it is evident that the error terms over the series have a constant mean and the variances and covariances are also stable. In essence there is an oscillation of the error values over the series where they regularly cross over the mean and reach maximum upper and lower values of equal, or nearly equal magnitudes. Figure 2.4 presents a different case where the mean of the errors is unstable (but the variance appears stable).

Figure 2.3 : Stochastic process with stationary mean



Source: Charemza and Deadman [1997]

Figure 2.4: Stochastic process with nonstationary mean



Source: Charemza and Deadman [1997]

Variable trends, including an error trend, can be said to possess white noise error or a **purely stationary** stochastic error process. If this is the case the residual graph would look very similar to Figure 2.3 with the mean and variance of the errors being stable over time. A graph of purely stationary white noise characteristic would move horizontally over time with repetitive swings

above and below the mean, while never maintaining an upward or downward trajectory for any length of time (i.e. showing a highly predictable pattern over time).

Economic and other time series rarely possess the above characteristics. Most variable trends move in either an upward or downward direction for periods of time only to change course again. This may be "due to the effects of the stochastic process or random shocks. This is true of the random walk process" (Charemza and Deadman, 1997: 88). The random walk is a special type of non-stationary series defined as:

$$y_t = y_{t-1} + \varepsilon_t \qquad \textbf{Equation 2.1}$$

where y_t is the value of the variable y at time t , y_{t-1} is the previous value of y at the last time interval and ε_t is the error term associated with the prediction. In such a case, it is clear that the value of a variable at a given time is made up of the momentum of the series (i.e. the previous value of the variable) and an error term. Another example is what is known as a *random walk with a drift* identified which can be shown as:

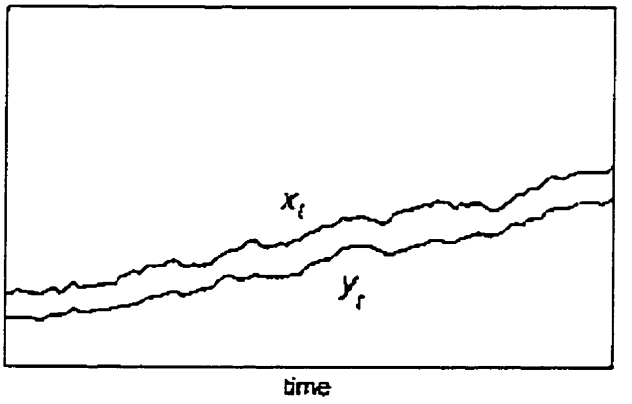
$$y_t = \mu + y_{t-1} + \varepsilon_t \quad , \quad \mu \neq 0 \qquad \textbf{Equation 2.2}$$

where the components y_t, y_{t-1} and ε_t are the same as above and μ represents a constant. The resulting series would veer (or drift) upward (or downward depending on the sign) and to the right over time as a function of the constant and the cumulative effect of preceding values of y. Clearly, the requirement of stationary stochastic process is not met in either of these cases because of the tendency of the variable to carry forward some of the value of the previous interval. While it would be easy to deal with perfectly stationary series using OLS, the occurrence of such phenomena is rare and therefore techniques have been developed to transform non-stationary variables.

According to Charemza and Deadman (1997: 84) a series is said to be *stationary in a strong sense* if

the joint and conditional probability of the process are unchanged if displaced in time. In practice, it is more usual to deal with *weak sense or covariance stationarity*, restricting attention to the means, variances and covariances of the process.

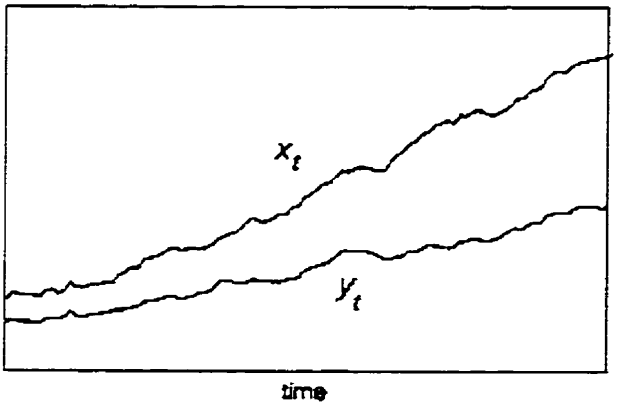
Figure 2.5: Example of a series whose linear combination y_t—x_t is stationary



Source: Charemza and Deadman, 1997: 124

In Figure 2.5, we can suggest the presence of a common attractor because of the maintenance of the difference between the series over time and the "lock-step" movement of the series (Deadman and Charemza, 1997:124). It is important to reiterate the fact that the two series need not be parallel at every interval in the series, rather it is the long run consistency or equilibrium that is

Figure 2.6: Example of a series whose linear combination y_t—x_t is nonstationary



Source: Charemza abd Deadman, 1997: 123

of interest. In addition to this parallel nature between the series, they must be determined to be integrated at the same order and possess stationary deviations from the same long run path.

Figure 2.6 presents two series x_t and y_t over a certain time period. It is evident that the trends are moving in the same general way but there are forces acting on one or both of them that are causing them to move farther apart over time.

Non-stationary series can be transformed to make them stationary. This process, known as "differencing", can force the means and variances of a series to meet the requirement of stationarity thereby returning OLS regression to the list of analytic tools. Differencing, usually synonymous with *first differencing,* is essentially the subtraction of the previous value of a time series variable from the current value to remove the trend from the series (Charemza and Deadman, 1997: 96). The equation below for first differences of a series with a stochastic trend of the type shown in Equation 2.1 is:

$$\Delta y_t = y_t - y_{t-1} = \varepsilon_t \qquad \textbf{Equation 2.3}$$

where ε_t is stationary. For second differences, the equation is more complex but the idea remains the same. These series must *have "the first differences of the first differences"* calculated before stationarity is achieved. For example if series $\boldsymbol{x}_t$ requires second differencing *(* $\boldsymbol{x}_t \sim I(2)$*),* the equation:

$$\Delta\Delta x_t = \Delta(x_t - x_{t-1}) = (x_t - x_{t-1}) - (x_t - x_{t-1}) \qquad \textbf{Equation 2.4}$$

makes the series stationary.

> By definition, a nonstationary series which can be transformed to a stationary series by differencing *d* times is said to be integrated *of order d.* A series $\boldsymbol{x}_t$ *integrated of order d* is conventionally denoted as $\boldsymbol{x}_t \sim I(d)$ (Charemza and Deadman, 1997: 97).

Testing For Cointegration

Differencing series to make them stationary is useful under certain circumstances. It renders the series more like a white noise process with a fixed mean and variance and meets the assumptions of OLS. Unfortunately, this alteration of the values eliminates the long term trends which are of great interest in studies of historical change. Still, differencing can tell us at the early stages if series are integrated of the same order and therefore if there is even reason to proceed with a test for cointegration. Engle and Granger (1987: 253) define the cointegration of two variables as the condition where time series x_t and y_t are said to be *cointegrated of order d, b* where $d \geq b \geq 0$,

$$x_t, y_t \sim CI(d, b) \quad ,$$

if:

1. both series are integrated of order d,
2. there exists a linear combination of these variables, say $\alpha_1 \cdot \mathbf{x_t} + \alpha_2 \cdot \mathbf{y_t}$, which is integrated of order $d - b$.

The vector $[\alpha_1, \alpha_2]$ is called a *cointegrating vector* and is represented by the error term created by the regression of the two variables

Borrowing from Brannigan and Lin (1999: 10), the cointegration of variables can be shown in two simple equations. If the time series y_t is modeled as a function of x_t and z_t, the following familiar regression equation (Equation 2.5) is used where μ represents the regression residuals.

$$y_t = \beta_1 x_t + \beta_2 z_t + \mu_t \qquad \textbf{Equation 2.5}$$

Now, if one were to rearrange the equation to predict μ_t (Equation 2.6) and the resulting series μ_t is found to be stationary, then the series y_t, x_t and z_t are <u>cointegrated</u> (or integrated together).

$$\mu_t = y_t - \beta_1 x_t - \beta_2 z_t \qquad \textbf{Equation 2.6}$$

Charemza and Deadman (1997: 125) somewhat encouragingly declare that

> for empirical econometrics, the most interesting case is where the series transformed with the use of the cointegrating vector become stationary, that is where $d = b$ and the cointegrating coefficients (the coefficients which constitute the cointegrating vector) can be identified with parameters in the long run relationship between the variables.

These are precisely the types of relationships that will be studied in the analysis of long term parity relationships between male and female crime.

The elementary discussion of the procedure must inevitably lead to the actual test which is considerably more involved, yet its substantive meaning is the same. It is possible to determine the order of integration using a plot of the residual series but there are few sustainable arguments for this method (Kennedy, 1992: 255). Dickey and Fuller (1979, 1981) proposed the unit root test for stationarity, aptly named the Dickey-Fuller test, and many statistical packages can compute this test statistic (Cromwell, Labys and Terraza, 1994: 13-14). For our purposes, this test was used to identify the order of integration of each of the variable series using *Estima's* RATS (1997). The augmented Dickey Fuller test (ADF) undertakes the same test with lags in the equation. Various inclusions to the test may be attempted (such as adding a trend, a constant, a constant and a trend or neither a constant nor a trend). For a complete discussion of the mechanics of the test see Cromwell et al. (1994) or Charemza and Deadman (1997). If two series are integrated at the same order, they can be tested for cointegration. In other words, if each series is non-stationary, but becomes stationary at the same level of differencing they may be related. This is tested through an inspection of the residuals created by the regression of y_t on x_t as noted above.

The Error Correction Mechanism

Up to this point, one could fairly argue that the results of these tests serve only to satisfy criteria and tell little of substantive interest. Such statements would be accurate but the preparatory work is crucial

The presence of two cointegrated variables which are both *I(1)* means that there is an error correction process (Mills, 1990: 273). A typical error-correction model can be expressed as follows:

$$\Delta y_t = \alpha + \sum_{i=t}^{t} \beta_{1t} \Delta x_{t-i} + \sum_{i=t}^{t} \beta_{2t} \Delta y_{t-i} + \sum_{i=t}^{t} \beta_{3t} \Delta z_{t-i} + \gamma z_{t-1} + \mu_t$$

Equation 2.7

where Δy_t is an endogenous variable, β coefficients suggest the effects of the changes of exogenous variables of x_t and z_t and the lagged changes of the endogenous variable Δy_{t-1} (since i = 1, 2 ...,) on the changes of the endogenous variable, and γz_{t-1} is the error correction term (ECT) presenting the long run relationship between endogenous and exogenous variables (Engle and Granger, 1991). Estimating an ECM models the long term dynamic, expressed as γz_{t-1}, along with the differenced exogenous variables (i.e. the short-term effects). As such it is possible to:

> capture the long-term dynamic expressed in the cointegration vector in a series of equations along with other short-term effects. The final model is called an error correction process because it captures the degree to which each series may diverge from the other over time and is returned to a state of equilibrium through an error correction mechanism (Brannigan and Lin, 1999: 11).

The analysis that will follow shall use these methods to examine the relationship between male and female crime rates for specific crimes and crime categories. Figures 2.7 thru 2.13 portray the double-y graphs of male and female specific crime rates which will be tested as part of the analysis. Figure 2.2 (presented earlier) provides the trends for male and female theft under. The initial analysis of these trends at the outset of Chapter 3 will address the issue of criminal convergence between the genders. That being complete, a second analysis, employing the same methodology, will explore the possibilities of cointegrated relationships using economic and demographic relationships in conjunction with the crimes under study. Some justification for the use of these other series follows and will briefly locate the relevance of these variable series in the literature, sociological and otherwise.

Figure 2.7: Male and Female Assault Rates

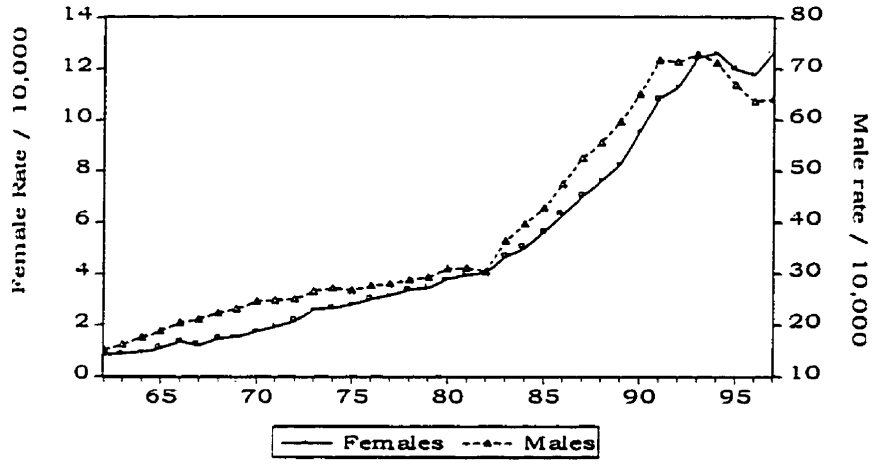


Figure 2.8: Male and Female "Homicide & Attempted" Rates

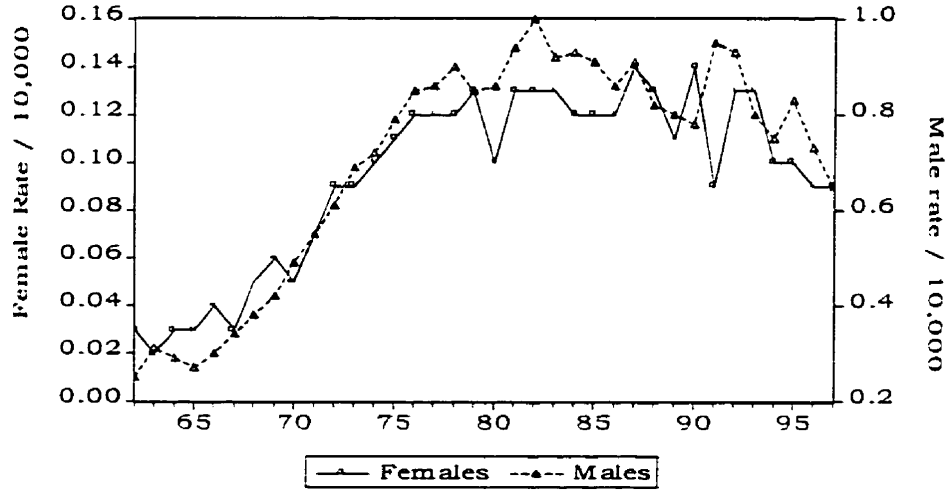


Figure 2.9: Male and Female Break and Enter Rates

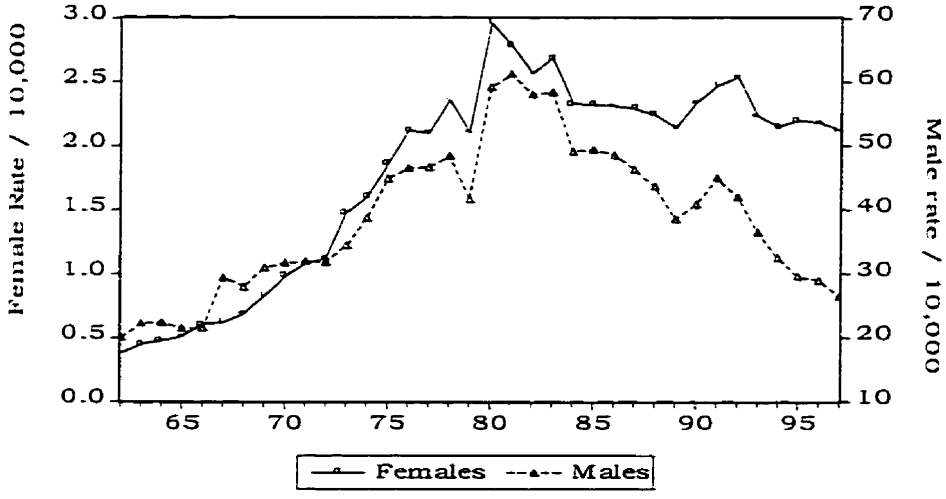


Figure 2.10: Male and Female Robbery Rates

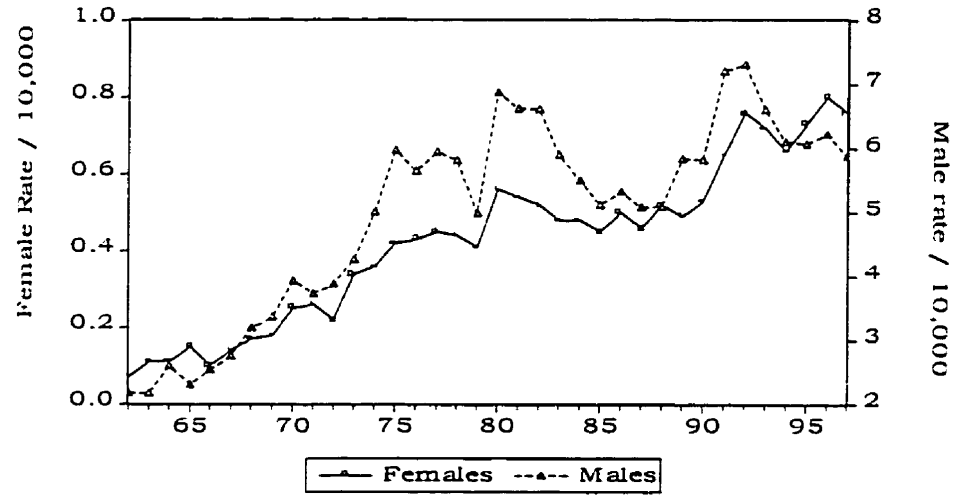


Figure 2.11: Male and Female Fraud Rates

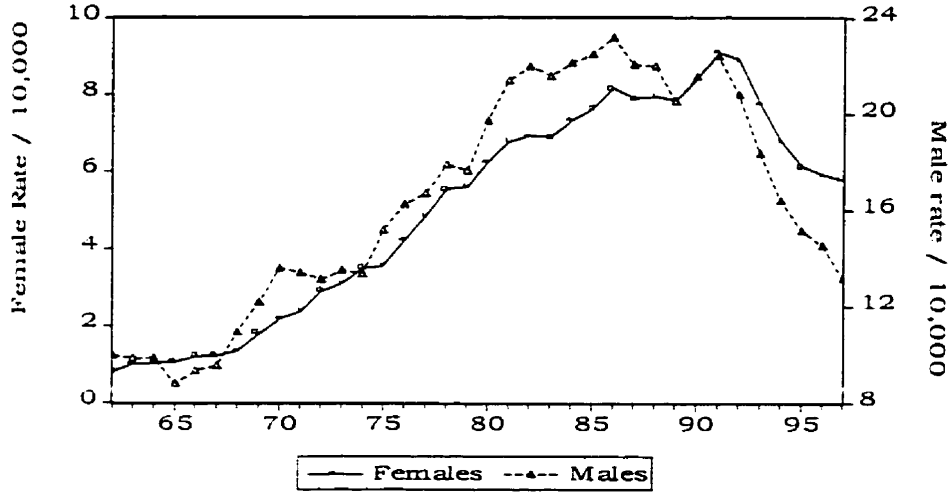


Figure 2.12: Male and Female Motor Vehicle Theft Rates

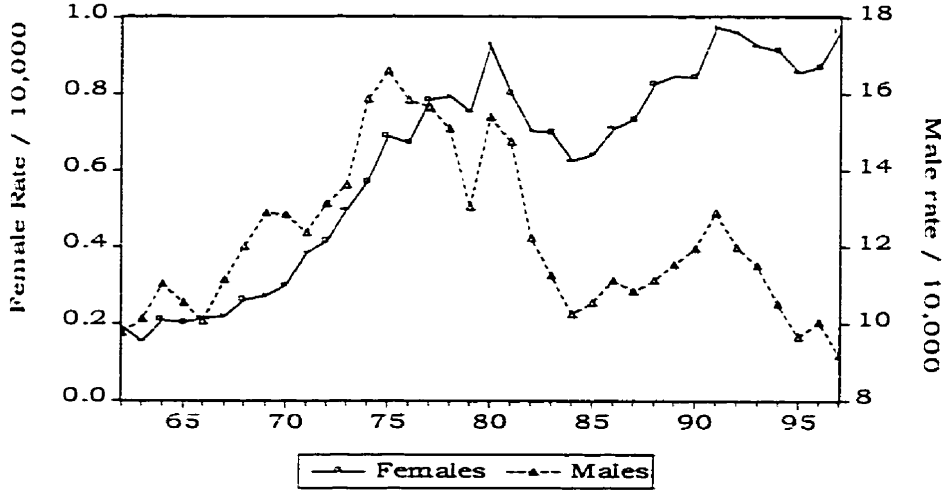
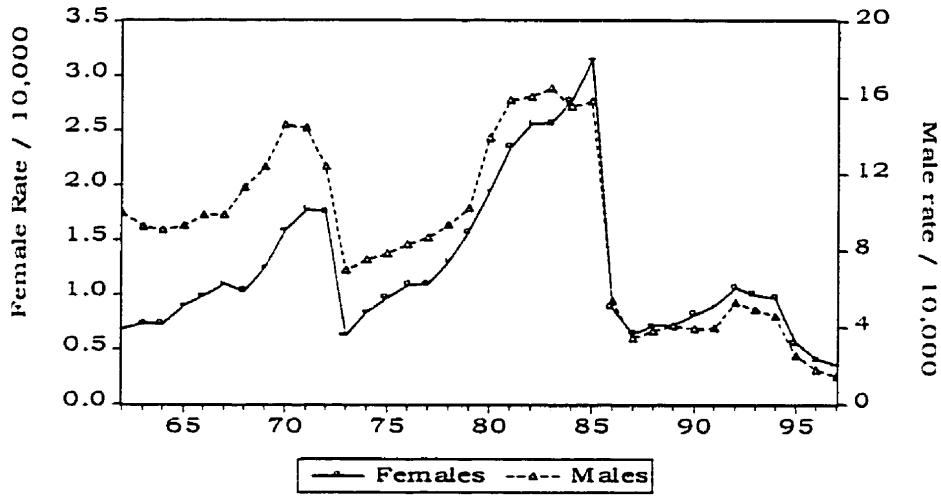


Figure 2.13: Male and Female Theft Over Rates



Theory, Exogenous Variables and Cointegrating Series

The criminological literature offers many explanations for crime. Some such explanations involve individual characteristics (psychosocial and biological), peer groups, families, race, age and sex. It is perhaps fortunate that neither the data nor the techniques exist to allow the inclusion of all possible contributors into a predictive model. For a time series analysis, the main restriction is the use of variables measured over a population at the same intervals in time thereby paring down the possible predictors. Because the government of Canada funds relatively accurate data gathering on an ongoing basis, the variables which are appropriate can be used with confidence provided the length of the series is not excessive. Now, with the use of the internet, many of these data are available without leaving the computer.

Earlier, it was mentioned that age (read young) and sex (read male) are variables usually presented as very positively related to crime. Also, the literature on marginalization clearly implied the compulsion of poor or relatively disadvantaged persons to become involved in crime. Strain theories of delinquency (Merton, 1938; Cloward and Ohlin, 1960; Agnew, 1985) provide theoretical and empirical evidence for believing that a certain amount of delinquent behavior can be attributed to the strain caused by lack of resources. In a time series analysis, the use of aggregate crime as the dependent variable

necessitates independent variables with similar aggregate coverage. The unemployment rate for Canada is suitable and available in both "age-specific and gender-distinct rates" or "total" form.

The use of unemployment to predict criminal activity is not new. Still, the ability to actually test the relationship has been expanded with the advent of new statistical procedures. Specific concerns regarding the analysis of time series data utilizing unemployment rates and crime rates have been raised (Freeman, 1983). Multicollinearity between the series as they move through time results in potentially very little variation and consequently it is difficult to estimate the independent effects of the predictors. Furthermore, interpreting the results from such an analysis can be challenged on the grounds that the unemployment rate merely causes the timing of crime, rather than the level of crime. As such, it is argued that people do not become criminally inclined because of unemployment, rather, those with a criminal inclination are more likely to act on it when unemployed. Some studies manage to produce results suggesting positive associations while others find inverse relationships. Consequently, the debate continues. Freeman (1983: 90) states

> [n]o one would gainsay that there is some correlation between the labour market and crime, but the strength and magnitude of the link are more subtle and difficult to determine than one might expect.

Strain theories of crime argue that crime is the outcome of an individual's frustration with his / her ability to achieve goals through legitimate means (Agnew, 1985; Hartnagel, 1998). Furthermore, some differences exist between males and females which are manifested in their responses to strain. Broidy and Agnew (1997) propose that males experience different types of strains than those of females. Furthermore, the gender distinct responses to strain are said to explain the different levels of crime for both sexes. Broidy and Agnew (1997: 277) draw on the empirical literature to examine four issues :

1. Males are subject to *more* strains or stressors than females.
2. Males are subject to *different* strains than females, with male strains being more conducive to crime.
3. Males have a different emotional response to strain, with the male response being more conducive to crime.

4. Males are more likely to respond to anger / strain with crime.

The issue of unemployment coincides clearly with the circumstances of female liberation and marginalization addressed in the last chapter (Box and Hale, 1983; 1984). The increasing involvement of women in the labour force should in part address the differences suggested in points 1 and 2 above. If women (continue to) perceive their strain as the result of oppressive rather than competitive forces as suggested by the marginalization hypothesis, in addition to possible social psychological differences between the genders, all four points above seem plausible (Broidy and Agnew, 1997).

Cross-sectional research (Lieber et al, 1994) suggests that the interaction effects of strain and liberation for women are insignificant. Therefore, strain does not increase with increased liberation. In addition, it was suggested that strain acted in the same way across the genders but the prevalence of strain was higher among males than women. Conclusive findings are hindered by the inconsistent and somewhat arbitrary operationalization of liberation. Naffine and Gale (1989) argue that the analysis of U-C relationships in South Australia indicates that the relationship between the two phenomenon only posits a relationship for males. They argue that theoretical and empirical arguments affirming the U-C relationship are only applicable if females are ignored in the development of the research.

Cantor and Land (1985: 329) suggest that the "oversimplified" causal unemployment-crime (U-C) relationship is misleading since "the total effect of the unemployment rate is the sum of the positive motivational and negative opportunity [read routine activities] impacts". Their research is able to show both positive contemporaneous and negative lagged effects of unemployment on crimes, depending on the crime being studies. In keeping with the economic explanation, homicide, motor vehicle theft, rape and aggravated assault fail to show measurable differences in their rates as a function of unemployment. Logically, this is consistent because of the unlikely economic motivation of such violent offenses (Cantor and Land, 1985: 317). Regarding acquisitive crime generally, Cantor and Land (1985: 319) contend as follows:

> Array the members of a population along [a] continuum according to their levels of [criminal] motivation . . . [a]ll other things being equal, an increase in the unemployment rate produces a shift in the density distribution of the population along this continuum toward its higher end. Thus the central tendency (mean, median) of the motivation density will have shifted upward. Furthermore, if it is assumed that the level of crime experienced by the population is an (unconditional) increasing function of the level of the central tendency of this density distribution, then it follows that the crime rate should increase.

Methodological critiques followed Cantor and Land's (1985) research to suggest that their techniques were statistically inadequate for their research (Hale and Sabbagh, 1991: 413). Following Hale and Sabbagh's advice, our research used cointegration techniques to allow the exploration of long run relationships between unemployment and crime in addition to the short term effects of other related variables. Unfortunately, these variables are again not easily operationalized and "the interrelationships here [are] complex" (Hale and Sabbagh, 1991: 413). Devine, Sheley and Smith (1988) concur with both camps insofar that they find both positive and negative U-C relationships based on the addition of variables representing government response affecting societal distress following unemployment.

Recent Scottish research (Reilly and Witt, 1992; Pyle and Deadman, 1994) has addressed these issues using both similar theoretical bases and methodological techniques. The former used an OLS regression to determine the effect of unemployment on crime. Failings of this research were evident in their inability to conduct proper cointegration tests because of the limited series length (15 years) and their failure to report Durbin-Watson statistics for the regression. Also, Reilly and Witt (1992) failed to disaggregate the crime rate used as the dependent variable stating "[o]ffenses are excluded from the definition since there is no *a priori* reason for why [specific] offenses should be linked to cyclical movements in the economy"(221). Granted, cointegration techniques were not possible, but the graphs included as figures 2.2, 2.7-2.13 indicate that for Canada there are clear differences in the signature of the rates for different crimes, especially property versus violent crime. This seems to provide ample *a priori* evidence of difference leading to visual indications of links between certain crimes and the unemployment rate. For example, clear

indications of the differences in the signature of crime rates can be shown in the trends for assault and theft-under, the two largest contributors to the overall violence and property crime rates respectively (figures 2.2 and 2.7) When comparing these Canadian crime trends with unemployment rate trends, as will be demonstrated later, the striking similarities (at least for property offenses) prompt further analysis.

Figure 2.14: Scottish Unemployment - Crime Relationship

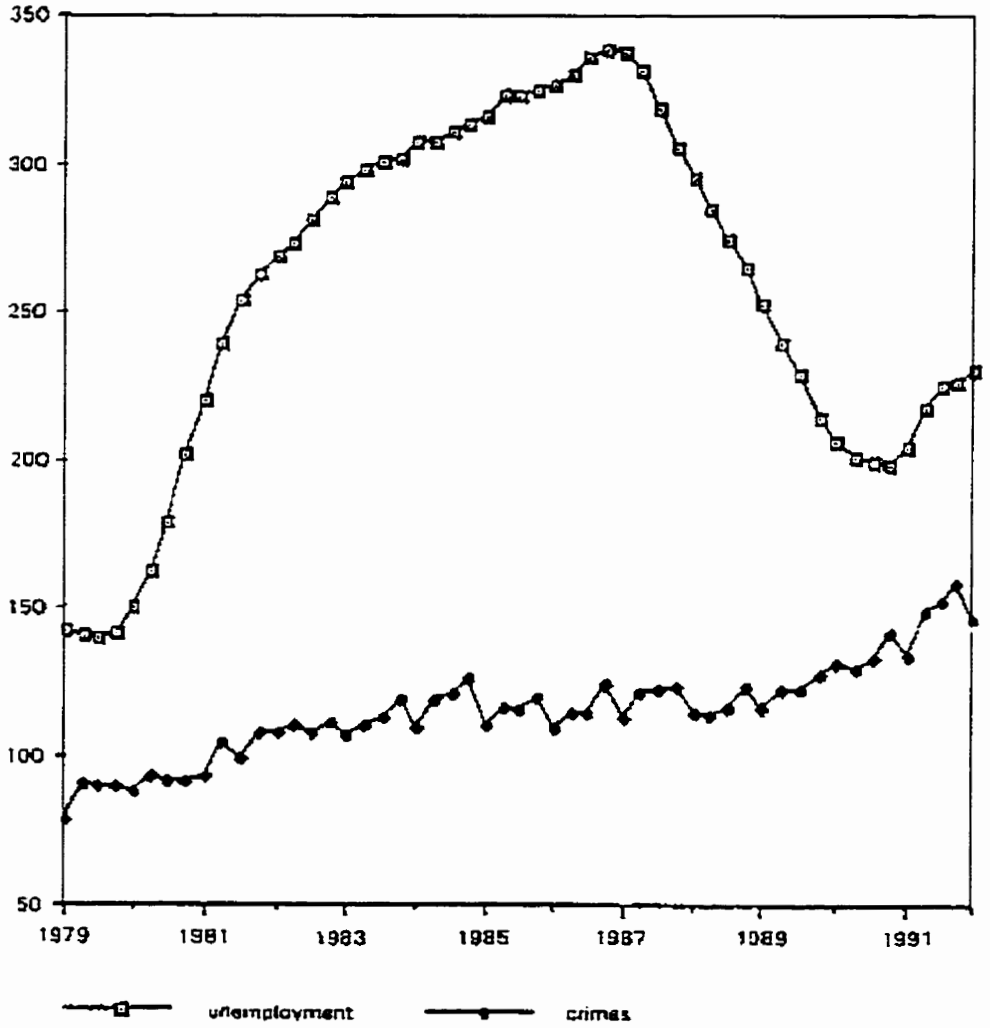


Figure 1. Crimes and unemployment in Scotland, 1979:1–1994:4, in thousands.

Source: Pyle and Deadman (1994)

Pyle and Deadman (1994) directly challenge the results and analysis of Reilly and Witt (1992). Asserting that "finding a strong correlation between rates of crime and unemployment needs to be interpreted with caution", the authors reestimated the earlier findings using an extended time series spanning from 1979 to 1991. By using quarterly observations, the number of useable data points was multiplied fourfold. Casual visualization of the graph of the dependent variable (total crime) and the unemployment rate led the authors to believe that the relationship showed little evidence of an U-C association (Pyle and Deadman 1994: 316). The graph presented in Pyle and Deadman (1994) has been reproduced as figure 2.14.

Clearly, the requirement of similarity through visual inspection is not met. As a result the conclusion of non-cointegration is hardly surprising. They state that cointegration analysis failed to show a common attractor process for this relationship. They note that similar tests with disaggregated data also failed to reject the null of non-cointegration. They conclude that the relationship between unemployment and crime is at best a static one and "that there is no support for the existence of such a relationship in a dynamic context, that is where crime and unemployment vary through time (Pyle and Deadman, 1994: 322).

In Canada, Schissel (1992) studied the effects of macro-economic, demographic and government response variables on the crime rate. Results indicated that using such models to account for all crimes is ineffective and is better suited to the analysis of specific offenses. Contrary to earlier findings, Schissel suggested that the effect of unemployment is "diminish[ed] to the point where both current and past significant estimates of unemployment are non-existent". Furthermore, it is concluded that these U-C findings

> endorse the conflict position that high unemployment rates compel governments to take action against an increasingly volatile population in the forms of increased criminal detection and punishment and increased placative social programs (Schissel, 1992: 423).

Plausible strain explanations could be forwarded based on the same results whereby the increases in government intervention is a justified simultaneous

and rational response to the increased criminal activity during periods of high unemployment and inflation.

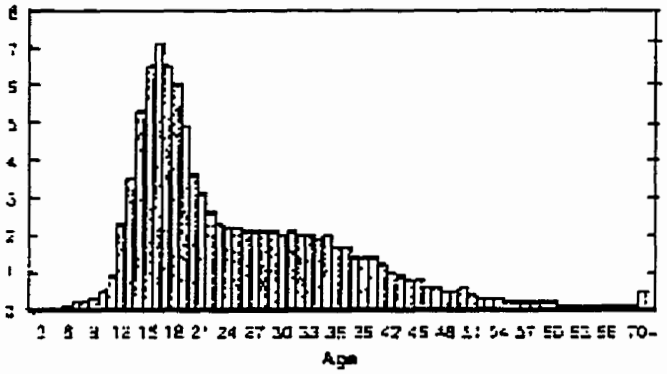
The flurry of research into the unemployment-crime nexus continues to fuel the debate. As expected, continued disagreement exists over the specification of models, operationalization of variables and direction of effects. Still, the continued research interest suggests the relevance of Freeman's (1983: 98) statement :

> Despite differences and weaknesses among the studies, a general finding emerges: namely, that rises in unemployment and/or declines in labour participation rates are connected with rises in the crime rate, but that the effect tends to be modest and insufficient to explain the general upward trend of crime in the period studied. [And] while none [of the analyses] shows unemployment to be the dominant determinant of crime, they do lend overall support to the notion that crime varies over the business cycle (Freeman, 1983: 96-98)

Population Age Structure and Crime

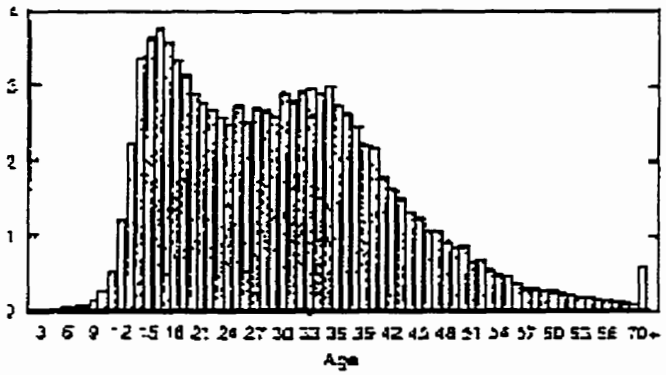
The lengthy discussion in the first chapter regarding the relationship between age and crime need not be repeated here. What should be addressed are the ways that demography and age differ conceptually in this analysis. Precise figures identifying the exact ages of offenders are not available for lengthy time series analyses. This information exists but is not readily available through Statistics Canada. Still, glimpses of the detail have been offered in special periodical publications for the CCJS (Juristat Bulletin 85-002-XPE). The information, presented in the form of bar graphs plotting age by property and violent crime arrests separately shine new light on some of the assumptions about the age- crime relationship explained in the first chapter. The figures presented in Juristat (1997) are reproduced below. Note in figure 2.14 how the age distribution for property offenses peaks very early as predicted (Gottfredson and Hirschi, 1990) and falls quickly only to plateau at a reasonably high level and then decline slowly. The difference between this presentation and that usually associated with property offenses is the continuation of a large proportion of property crime into the late twenties. The median age for property crime is twenty-four years but the publication reports

Figure 2.15: Persons Accused of Property Crime by Age, 1997



Source: Non-random sample of 179 police agencies representing 48% of the national volume of crime. The data are not nationally representative.

Figure 2.16: Persons Accused of Violent Crime by Age, 1997



Source: Juristat Bulletin 85-002-XPE (1997)

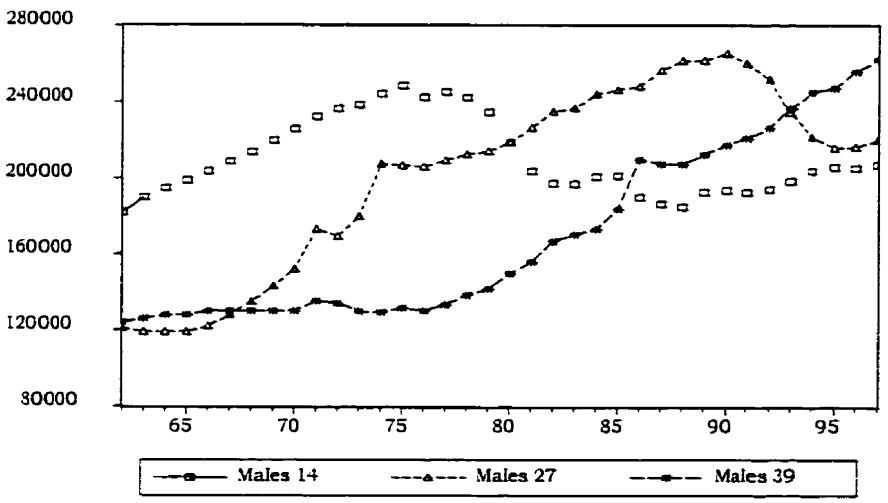
that only 40% of all property crime is committed by males 13-20 years of age, the group typically blamed for the majority of property offenses.

In figure 2.16, it is interesting to note that violent crimes are also not distributed as one would surmise based on the literature. The expected peak in the late teens and early twenties occurs as expected but there is a second peak in the late thirties (with an overall median age of twenty-nine years) which provides contradictory evidence to the research. Usually, it is suggested that violent crime peaks in the early years and then declines, only more slowly than property crimes (Gottfredson and Hirschi, 1983). Reasons for this are provided

in research focussing on social capital (Sampson and Laub, 1993; Macmillan, 1995), self control and maturation (Gottfredson and Hirschi, 1983; 1990) and the alleviation of strains (Agnew, 1985; Schissel, 1992) among others.

From this indication that the age-crime relationship is not absolute, the estimation of models based on an age distribution becomes enticing. Data for males and females of particular ages are available through Statistics Canada providing *actual census figures in addition to inter-censal estimates.* These figures exceeded the merits of an initial research strategy based on the acquisition of absolute birth numbers by sex (lagged the appropriate number of years). We abandoned this approach since it was unable to account for the possible effects of immigration and death. These data by individual year of age (i.e. number of persons at each age) can allow tests of individual ages' contribution to a crime. Furthermore, these ages can be added to error correction models through the introduction of their short term effects to a cointegrated relationship. Generally, a plot of persons of a particular age over time resembles a smooth rolling hill. Several such ages on a single graph produce wave-like patterns. Figure 2.17 portrays the age structure curves for males aged fourteen, twenty-seven and thirty-nine over the 1962-1995 series.

Figure 2.17: Population Totals for Males at Selected Ages, 1962-1997



Easterlin's Hypothesis of Econo-Demographic Causality

Richard Easterlin (1978; 1979; 1980) introduced a combined form explanation for changing patterns in crime over time. Through the conjoining of demographic and economic variables, Easterlin proposed that many social changes can be predicted. The premise of the hypothesis is that population structure changes at different periods can have effects on the economic conditions through the increase of competition for jobs and resources. This condition of large cohorts has the effect of increasing the strains on the population through an increased unemployment rate and other manifestations of diminished resources per capita. Easterlin (1978) cites the long tradition in sociology running specifically from Durkheim's theory of anomie, in addition to relative deprivation, which gives strength to the argument of relative status causing social disorganization and alienation. Later, Easterlin (1980: 101) states:

> If a large generation experiences more psychological stress, it is likely to show behaviour symptomatic of such stress. If feelings of inadequacy are more prevalent, mental depression and, at the extreme, suicide will be more frequent. If feelings of resentment and bitterness occur more often, antisocial behaviour, such as crime, is likely to become more common. Thus larger generations are likely to show higher rates of crime and suicide than smaller.

Earlier, Easterlin (1978) made predictions of the upcoming decades' crime problems and social conditions based on the above ideas. It was suggested that the conditions of high unemployment, high crime and high inflation would be offset by the coming of age of smaller cohorts of young people borne to the baby-boomers. Early explanations of the rise in crime associated with the sixties offered simple demographic explanations of the association (Wellford, 1973). Simply put, these explanations reduced the increase in crime to an increase in the proportion of the population in the crime prone ages. If this were the case, there would be no evidence of increasing *rates* of crime for the individual age groups because of the ability of a rate to control for the changing population. In fact, there has been a dramatic increase in the rates of crime, especially in the younger cohorts (Easterlin, 1980; Maxim, 1985). A compelling argument could, and will, be made for this association. Additional economic

considerations will also be introduced to further capture the contributions of strain or stress that Easterlin proposed.

The use of demography and age structure has produced some interesting results regarding the changing rates of crime by gender. Won Lee (1984) provided evidence of female increases in crime which were steeper than male rates and the greater acceleration of rates for younger persons for Canada over the period 1949-1968. The use of conviction data poses some concern in the interpretation for the reasons mentioned earlier. Also, some visual inspections of the rates were potentially misleading because of the different appropriate rate scales across the genders.

Tests of the Easterlin hypothesis have provided some support for the causal connections but the findings are inconsistent. Maxim (1985) found modest support for the cohort effect on rates of delinquency but suggested further that changes in the handling of juveniles may be responsible for much of the change witnessed in juvenile crime. Steffensmeier, Streifel and Harer (1987) also address this issue by stating that criminal justice systems, in an environment having large crime prone cohorts, may experience a saturation resulting in the spread of resources to the point where a leveling off of crime rates will occur. Maxim's (1985) research, in addition to others (Steffensmeir, Streifel and Harer, 1987; O'Brien , 1989; Menard, 1992; Steffensmeir, Streifel and Shidadeh, 1992;) used an age-period-cohort framework to test their models. Maxim (1985: 666) notes:

> Although some authors have suggested that it does not make sense conceptually to speak of three distinct effects, the consensus appears to be that this perspective is overly restrictive. The position taken in this study is that while age and cohort effects cannot be considered as mathematically orthogonal to each other, they do constitute unique effects from a substantive perspective.

O'Brien (1989) established relatively weak but significant effects of cohort size on property crimes (excluding motor vehicle theft) over five cross sectional periods. For assaultive crimes, little support was provided for Easterlin's theory. The failure of the cohort size to predict violent crime rates indicates either that it is an unacceptable concept or that the age crime curve should be re-visited. Based on the earlier Juristat presentations (Figures 2.15 and 2.16),

it is suggested that the usual estimation of "crime-prone" cohorts should be reconsidered. Similarly, Jolin and Gibbons (1989) identify the potential of several age–crime relationships including later-onset criminality and career criminality. Menard (1992: 195) suggests that results of models including the usual age-period-cohort measures in addition to variables measuring social control and strain are useful.

To summarize, this research will argue for a trimmed version of the Easterlin hypothesis suggesting, as Maxim (1985) noted, that there is no need for multiple measures of age distributions. Cohort effects are captured by the

Figure 2.18: Males Aged 22 & 29 and Male Theft Under

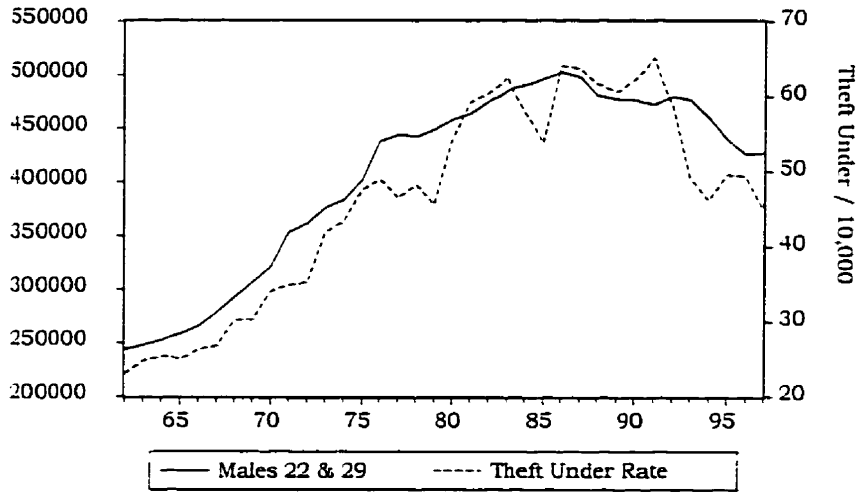
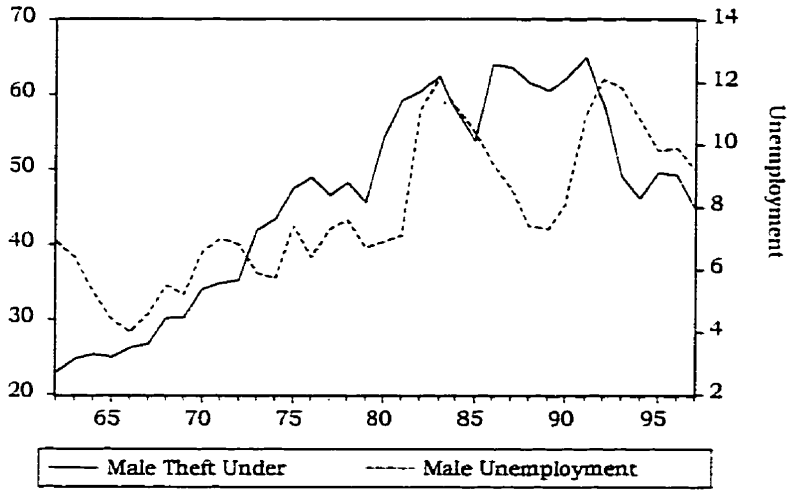


Figure 2.19: Male Theft Under and Male Unemployment



use of specific age counts for both genders over all of the years involved. Furthermore, the selection of ages will depend on the results of inspections of actual age-crime distributions, visual sensibility and tests of credible alternatives. The addition of economic indicators in the form of unemployment rates will provide measures of one prominently identified source of strain. Therefore crime rates will be estimated in a number of ways in the following analysis:

- Initial tests for cointegration between the crime rates of the sexes will be undertaken to establish or dismiss convergence for specific crime categories.
- Unemployment (total, gender specific and age specific) will be tested as a predictor of crime rates through the use of cointegration techniques.
- Demography (specific ages or group ages by sex) will be estimated as a predictor of property and violent crime rates based on indications from government publications regarding the actual age-crime distribution in Canada. Again cointegration techniques will be used.
- Demography, measured in terms of persons of a particular age (or persons of particular ages added together) will be tested for cointegration with crime rates. Also, the additional short term effects of simultaneous and lagged unemployment will be introduced into the equation to address Easterlin's proposed demographically induced strain as causative of criminal activity.

Figures 2.18 and 2.19 provide reasonable expectations for the possibility of a cointegrated relationship between the trends for demography, unemployment and crime. For the present time, interesting suggestive relationships exist between unemployment (males only) and specific male crime (theft under). Also, the relationship between male demography (males aged 22 & 29) and male theft under seems plausible as cointegrated based on initial inspection. Completing the syllogism, then, we can reasonably assume that a relationship also exists between unemployment and demography. The creation of the trend for male population 22 and 29 (added together) will be explained in the next chapter but suffice it to say that strong intuitive and visual reasons exist for exploring Easterlin's hypothesis as it pertains to crime.

Chapter 3: Data Analysis and Results

The results of various preliminary and intermediate tests (pre-cointegration) are presented. Considerable effort must be expended on ascertaining the levels of integration of each of the variable trends before proceeding with cointegration tests and error correction models. It is possible to find extremely compelling results produced from equations where the actual test is meaningless due to the different integration orders of the component variable trends. For this reason, table 1 (provided below) is dedicated to the initial stage of the analysis—testing for stationarity.

Tests of Stationarity

Prior to investigating the possibility of cointegration, it must be determined that the variables in question are integrated at the same order. That is, they either are stationary as they are (*at levels*) or become stationary after some transformation (*first* or *second differencing*). Recall from the previous chapter that tests for cointegration are only undertaken between variables that are integrated of the same order. To carry out these tests, the Dickey-Fuller Test and the Phillips–Perron Test were utilized testing for stationarity first at levels with only a constant, then at levels with a constant and a trend, and finally at first differences with a constant.

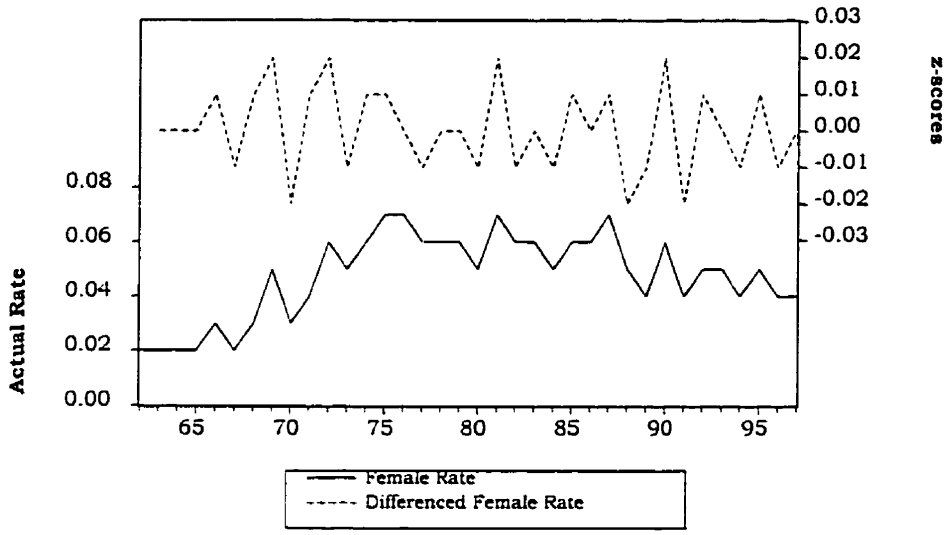
From Table 3.1, it is clear that virtually all of the gender specific variable trends are non-stationary at levels but become stationary at first difference. The one exception to this is female murder with a DF Test Statistic of –2.67 (Critical Value = -2.61 $\alpha<0.10$) suggesting that at the 10% level we should reject the null of non-stationarity. Within our analysis, this anomaly is not a surprise because a visual inspection of the female trend for murder portrays a category with extremely small values over all of the years and the tendency of those values to remain around a relatively steady mean. These features of stable variance and mean are the two defining characteristics of stationarity. Figure 3.1 provides a graph of the actual value for the female murder rate on the lower portion of the graph as well as the variable at *first differences* on the upper portion of the graph. Clearly, there is an improvement in the stationarity

Table 3.1: Dickey-Fuller (DF) and Phillips-Perron (PP) Tests for Non-Stationarity

	(DF) Test at Levels with Constant	(DF) Test at Levels with Both Constant & Trend	(PP) Test at Levels with Constant	(DF) Test at First Difference with Constant	(PP) Test at First Difference with Constant
Female Crime Rates					
Assault	1.88	-1.32	1.24	-3.32**	-3.32**
Attempted Homicide	-2.07	-1.76	-2.09	-10.02***	-9.73***
Murder	(-2.67*)	-2.47	-2.52	-9.30***	-10.16***
Murder & attempted	-2.00	-1.66	-1.89	-9.73***	-9.74***
Robbery	-0.85	-2.82	-0.69	-6.65***	-7.00***
Violence	1.60	-1.40	1.11	-3.69***	-3.71***
Break & Enter	-1.80	-0.90	-1.83	-7.01***	-6.89***
Fraud	-1.74	1.28	-1.53	-2.82*	-2.74*
Motor Vehicle Theft	-1.32	-1.66	-1.07	-5.33***	-6.02***
Theft Under	-2.36	1.06	-2.11	-3.90***	-4.01***
Theft Over	-1.96	-1.94	-2.12	-5.53***	-5.52***
Male Crime Rates					
Assault	-0.20	-1.14	-0.50	-2.92*	-3.03**
Attempted Homicide	-1.91	-0.63	-1.94	-5.80***	-5.80***
Murder	-1.75	-0.69	-1.74	-6.36***	-6.36***
Murder & attempted	-2.03	-0.14	-2.03	-4.92***	-4.90***
Robbery	-1.84	-1.79	-1.83	-6.20***	-6.24***
Violence	-0.49	-1.03	-0.69	-2.70*	-2.80*
Break & Enter	-1.52	-0.65	-1.56	-5.75***	-5.76***
Fraud	-1.22	1.35	-1.37	-3.31**	-3.32**
Motor Vehicle Theft	0.16	-1.65	-1.57	-5.22***	-4.91***
Theft Under	-1.77	-0.33	-1.77	-4.93***	-4.85***
Theft Over	-1.06	-1.70	-1.45	-4.51***	-4.47***
Unemployment Rates					
Total Unemployment	-1.25	-2.16	-1.32	-3.96***	-3.71***
Male Unemployment	-1.46	-2.62	-1.57	-4.23***	-4.04***
Female Unemployment	-1.31	-1.14	-1.33	-3.42**	-3.12**
Critical Values α<.01***	-3.6289	-4.2412	-3.6289	-3.6353	-3.6353
α<.05**	-2.9472	-3.5426	-2.9472	-2.9499	-2.9499
α<.10*	-2.6118	-3.2032	-2.6118	-2.6133	-2.6133

Test statistics for the above tests were produced using Estima's RATS and EViews from QMS. Critical values for the tests were provided by EViews based on Mackinnon (1991) for a sample size of 36. Critical values for the 1%, 5% and 10% are provided due to the stringent nature of the test. Note that at first differences only Female Fraud and Male Violence are significant at the more relaxed level of significance.

Figure 3.1: Approximate White-Noise Process at Levels for Female Murder Rate



of the trend at first differences suggesting that the stationarity at levels is borderline.

Later in this analysis, age-specific gendered crime rate trends will also be introduced in an effort to identify differences across the age groups. Again the Dickey-Fuller and Phillips-Perron tests were performed on these variable trends (not shown). It was discovered that for the same reasons mentioned above, the trends for juvenile male and female murder, in addition to adult female murder were found to be stationary at levels using the 10% critical value (-2.61). In an attempt to be as inclusive as possible, it was deemed necessary to stabilize these very erratic trends by eliminating both the murder and attempted homicide categories for both adult and juvenile females as well as juvenile males in favour of a summative category tabled as "murder & attempted murder". This addition of the two rates results in larger absolute values for the trends thereby eliminating the naturally occurring white noise which causes the marginal stationarity at levels. In future tables the individual categories for these three groups (excluding adult males) will be discarded and "murder & attempted murder" will take their place. For adult males, the categories will be

kept separate, as adult male murder was not stationary at levels due to the greater participation of adult males in murder.

No other gendered variable trends in table 3.1 achieve stationarity at levels even using the 10% limit of rejection. To test for trend stationarity, the Dickey-Fuller test at levels including both a constant and a trend was also performed (table 3.1, Column 3). Again, the inclusion of a trend in the test equation failed to identify any new variables which could be characterized as trend stationary. The third Dickey-Fuller test performed (table 3.1, Column 6) ostensibly tests the variables in the same way as column 1 of the table. The only difference is that the test was performed on variable trends which had been *first differenced* in the same manner as was shown in the top portion of figure 3.1. In effect, the differencing of variables removes the long-term component of a series thereby restricting the analytic possibilities. As a result, it is merely the knowledge of the order of intetgration gained through this diagnostic procedure which prompts these differencing transformations. Once the trends are found to be integrated at the same level, it is preferable to proceed using the original trends rather than a differenced trend thus maintaining both the long and short-run variability of the series.

The results clearly indicate that all of the variables are indeed integrated at order one, denoted *I(1)*. Only female fraud and male violence show a significance level of less than $\alpha<0.05$ and still they both are able to exceed the critical value cutting off 10%. Because of the nature of time series data and the ease at which null-hypotheses can be rejected, the 5% level of significance requires students-t values very near –3.00 (see critical values on table 3.1). Thus, it could well be argued that a value satisfying the 10% critical value should not be discounted. Software packages producing test statistics for stationarity routinely report all three critical values. The time series software program *SHAZAM* reports only the $\alpha<0.10$ value suggesting that our acceptance of these results is not overly liberal. In the same way as this relaxed level of significance resulted in the exclusion of female murder, it will allow for the retention of female fraud and male violence.

To verify the results of the stationarity test at this crucial initial phase of cointegration exploration, the Phillips-Perron (PP) test was performed on all of

the variable trends both at levels and at first differences. The results were not markedly different from those produced by the Dickey-Fuller tests with the exception of female murder. The PP test suggests that female murder is non-stationary at levels. The inconsistent results for female murder reinforced the necessity to eliminate the specific category and replace it with murder & attempted murder. The substantive meaning of the results from figure 3.1 are not overly interesting but rather preparatory. At this point, some explanation should be offered in part to foreshadow the discussion and to shed additional light on the explanation of these findings as well as those of the upcoming tables. The results in table 3.1 indicate that the trends for all of the variables, excluding female murder, are stationary after first differencing. This allows us to proceed to a test of stationarity of the residuals produced by the cointegrating regression of male crime rates on female crime rates.

Crime Between the Sexes

Table 3.2 provides the results of these tests of cointegration where male rates were denoted the endogenous (dependent) variables and female rates were the exogenous (independent) variables. Trials were conducted using female rates as endogenous and male rates as exogenous. The results (not presented) were consistent across both variations. The results indicate that there is a stationary residual series produced (either simultaneous or lagged) by the cointegration of female and male assault, murder & attempted murder, violence, and theft-under. Earlier analyses indicated that age specific cointegration tests demonstrated stationary residual series at the 5% level for adult male and female robbery and at the 10% level for juvenile male and female fraud and robbery. The additive effect of juveniles and adults in the categories male / female robbery and male / female fraud did not indicate a stationary residual series. This is likely due to the differing participation rates of adults and juveniles in robbery and fraud. Again, in an effort to identify all of the cointegrated crime trends, robbery and fraud are presented in table 3.2 differentiated by sex and age, in addition to the more simple gendered rate results.

Table 3.2: Co-integrating Regressions and Tests for Non-Co-integration Between Gender-Specific Crime Rates

Exogenous Variable			Endogenous Variable
Female Crime Rates	**DF**	**ADF (Lags)**	**Male Crime Rates**
Assault	0.31	**-3.57 (4)****	Assault
Murder & attempted	**-7.14*****	**-4.72 (1)*****	Murder & attempted
Robbery	-1.61	-1.72 (3)	Robbery
Robbery Adult Female	**-3.05****	-1.82 (1)	Robbery Adult Male
Robbery Juvenile Female	**-2.88***	-1.81 (3)	Robbery Juvenile Male
Violence	0.41	**-4.13 (4)*****	Violence
Break & Enter	-0.01	-0.01 (1)	Break & Enter
Fraud	0.30	-0.33 (2)	Fraud
Fraud Adult Female	0.36	-0.02 (2)	Fraud Adult Male
Fraud Juvenile Female	**-5.06*****	**-4.33 (1)*****	Fraud Juvenile Male
		-2.78 (2)*	
		-2.65 (3)*	
Motor Vehicle Theft	-1.09	-1.25 (1)	Motor Vehicle Theft
Theft-Under	**-2.93***	**-3.24 (1)****	Theft-under
Theft-over	-1.60	-1.21 (1)	Theft-over
***p<0.01	-3.6289	-3.6353	
Critical Values **p<0.05	-2.9472	-2.9499	
*p<0.10	-2.6118	-2.6133	

Asterisks indicate the rejection of the null hypothesis of non-cointegration.
*p<0.10 **p<0.05 ***p<0.01
QMS EViews produced the critical values for all DF and ADF tests (in this table and the following tables) for a sample size of 36. Test statistics were produced using *Estima's* RATS. Numbers in parentheses indicate lag at which the t-statistic becomes significant for the test.

The presence of a stationary residual series provides evidence that the two trends are moving in unison (cointegrated) although at extremely different magnitudes. The sum of all of the cointegrated crimes was calculated by reverting away from the rates and back to the absolute number of offenses. The total number of violence charges during the period was 2,593,307 with property charges equalling 7,258,106 over the thirty-six years. This analysis concerned itself only with those criminal code charges which were classified as

Table 3.3: Total Co-integrated Charges

Cointegrated Crime Trends	Total Charges
M/F assaults (All)	2,051,320
M/F murders and attempted murders (All)	36,072
M/F robberies (All)	245,708
M/F frauds (Juveniles Only)	51,155
M/F theft-under (All)	2,964,033

"property crimes" or "violent crimes". The percentage of total offenses (both violent and property) which can be explained as being cointegrated across the genders is calculated to be 54.3 % (see below).

$$percentage = \frac{5{,}348{,}288}{9{,}851{,}413} \times 100 = 54.29$$

Regarding only property offenses, 41.5% of the offenses over the series can be characterized as cointegrated. For violent offenses (including assault, murder & attempted murder and robbery) the percentage of total offenses testing out as cointegrated is a stunning 89.97%.

What this suggests is that there is evidence suggesting that male and female violent crimes have more in common than do male and female property crimes. Males are consistently many times greater than females in offense quantity but over the long run, an underlying process seems to exist driving both male and female rates of violent offense. In the case of violent crime, there is no question that this common attractor is very strong and that changes across the relative offense rates of the sexes are minimal. Approximately nine-tenths of all violence offenses since 1962 show a constant relative distance, well before Adler's (1975) chosen year of female emancipatory criminogenesis. The changes viewed in female rates of offending were not significantly different in their patterns of progression than those of males over the same period.

The relatively weak results for property crime should not be credited as outright evidence of convergence brought about by skyrocketing female crime. Because of the nature of some of the crimes which failed to meet the requirements of cointegration, some explanation is necessary. For trends to be

non-cointegrated, or possess non-stationary residuals, we can be certain that the trend lines are in fact moving farther apart or closer together, either through a divergent or convergent mechanism. Consider for example break and enter, motor vehicle theft, theft-over and fraud, all of which failed the test for cointegration. Clearly, female involvement in these offenses has increased over the period but male involvement has not remained static. Figures 2.9, 2.11, 2.12 and 2.13 (pages 59-61) portray the double-y trends for these non-cointegrated crimes.

In the case of break and enter (refer back to figure 2.9), the rate trends indicate that there has been clear divergence over the last portion of the series, particularly from 1984 onward. Still, in 1997 the male rate remains twelve times that of females down from twenty times greater in 1980. Both trends have a common signature, are moving in a downward direction and have been for most of the years since their pinnacles in 1980. If one chooses to consider this as convergence then it must be conceded that females are not exceeding in upward acceleration but rather are slower to decline than males. Male rates for B & E have dropped by approximately 55% to under 30/10,000 whereas the female decline has been a more modest 33% from a high of 3/10,000 to about 2/10,000.

Figure 2.12 indicates much the same process exists for motor vehicle theft. Until 1980, the rates followed each other closely only to diverge with both female and male rates maintaining the same signature but males participation per capita in this offense declined more quickly. Between 1980 and 1997, the male rate dropped from approximately 16 to 9 per 10,000 (-44%) whereas the female rate rose from 0.8 to 1.0 per 10,000 (+25%). At first glance, interpretation of these percentage changes can be promising for convergence theorists. True, at this rate convergence could occur at some point in the future but even in light of these interesting disparate changes by sex over time, it is necessary to remember that males are still nine times more involved in motor vehicle theft.

Figure 2.13 is somewhat different in that the divergence in the trends is actually in the early part of the theft-over series. After 1972, there has been virtually no difference in the trend patterns across the sexes. Because of the

changes in the definition of theft-over the course of the series, some of the wide swings in both rates can be explained as an artifact of categorization. In the same way that figure 2.12 suggested a negative convergence, theft-over arrests for females are not rising up to the level of males but rather both rates are dropping toward zero in a united fashion.

Fraud rates, as portrayed in figure 2.11, warrant some inspection. We now know that these trends are not cointegrated yet their long-run similarities are obvious. The vertical axes on this graph are rather similar in scale across the genders, which tells us that women are participating in fraud at a rate relatively similar to males when compared with other crime rates. Also, the female rate is dropping at a slower pace than males to almost one-half the male rate in 1997 up from one quarter in 1986. With the disparity between the rates being roughly 2:1 it is conceivable that a continued male decline and a leveling off or an increase in female fraud could result in convergence in the not so distant future. Still, at this point we are unable to speculate about the future of the trends but we can say, consistent with many US reports and Canadian findings (Hartnagel and Gibbs Van Brunschot, 1994), that fraud is a specific offense where convergence (in absolute offenses numbers) has the best chance of being realized.

In light of the findings of the formal tests for cointegration and the implication that cointegration has for convergence (both cannot be asserted simultaneously), most avenues of exploration suggested in the convergence literature have clearly become blocked. To use cointegrative techniques and find that about half of all property crime and nine-tenths of violent crime rate trends are cointegrated, we should not proceed to distinguish male and female crime causality using different predictive models since both forms of crime appear to reflect the same underlying process. As mentioned above, both through textual references and the graphical portrayals of the non-cointegrated crime trends (pages 59-61), we can explain theft over, break and enter and motor vehicle theft in ways which at best concede weak convergence and arguably present a downward convergence or classification based statistical artifacts, rather than an upward acceleration which began the debate in the

first place. With only fraud presenting itself as likely convergent, the thesis at this point would be left with little more to say.

In the interest of parsimony, acceptance of the findings denying convergence as well as explanations for those series which proved not to be cointegrated begs theorizing about the differences between male and female crime. Clearly, there are differences in magnitude across all crimes and our assertion of an underlying process does not address this issue, nor can it. Other theoretical explanations for the difference between male and female crime levels generally can serve better to explain the differences in criminal participation using data which are tailored to the investigation of individual characteristics and their contribution to criminality. At the aggregate level, there are many questions which, although important for criminology generally, are hazardous because of the potentially misleading interpretations which could result from the uncertain interference of the ecological fallacy (see Fox, 1999: 150).

Because of the points raised in the above paragraphs, we are left at this junction with three options: (a) conclude the thesis by asserting that convergence hypotheses fail under the rigors of this new testing technique, (b) attempt to explain the four non-cointegrated crimes in great detail with speculative age and sex-specific justifications which would contradict the significance of the general explanations (common attractor processes) that have been verified by the tests, or (c) advance into additional (non sex-specific) modeling using aggregate level data and the theoretical work which exists already, namely strain theory and Easterlin's contention regarding the function of demography and economy in causing crime. The first option is acceptable but not particularly enticing because we would only be settling a debate and not advancing our understanding of crime causation. The second option is weak because of our inability to be conclusive in our interpretation of these differences and thus pursuing this direction would likely create more questions than it answers. Finally, our last option both avails necessary theory and rationale on this project to allow us to address differences in crime-specific explanations through the use of both aggregate economic variables

(unemployment rates) and demographic (age structure) variables to show that differences exist between crime types.

To that end, an exploration of the relationship between crime and unemployment will lead with a subsequent exploration of age structure and crime. Finally both will be combined, in keeping with Easterlin's hypothesis to demonstrate the relationship of both of these macro-variables with crime. We would expect that unemployment will be related to acquisitive crimes and not to violent crime. This in part is derivative from the study of gender since, at least theoretically, part of the explanation of crime has been economic marginalization. We also suspect that the demographic makeup of society will impact crime generally but will act differently over crime types. Are these the things (demography and unemployment) which explain the common signature of male and female crimes? Through the use of age-crime distributions for property and violent crime categories, there is justification for believing that there are clear differences in the age-proneness by crime type. With these points in mind, we will now proceed to test for cointegrated relationships between economic conditions and crime.

Unemployment and Gendered Crime Rates

As will be recalled, part of this analysis involved the suggestion that unemployment and crime rates possessed similar signatory characteristics and therefore could possibly be cointegrated. This was based on Merton's theory of Anomie – or the block between aspirations and legitimate opportunities caused by the lack of work. Tables 3.4 and 3.5 present the results of cointegration tests of total gendered crime rates with total unemployment rates for the population. Also, sex-specific unemployment rates were tested against the crime rates of the same sex. This allows us to discern whether, for instance, female theft-under is more closely connected with the overall unemployment of the population or the unemployment of the entire *female* population.

The results in Table 3.4 indicate that female rates for "murder & attempted murder", break and enter, fraud and theft-under are all cointegrated (either simultaneously, at lags or both) with both the general and specific unemployment rates. Female robbery and fraud are only impacted by the

Table 3.4: Cointegrating Regressions and Tests for Non-Cointegration Between Female Crime Rates and Unemployment

Endogenous Variables	Exogenous Variables			
Female Crime Rates	**All Female Unemployment**		**Total Unemployment.**	
	DF	**ADF(Lags)**	**DF**	**ADF(Lags)**
Assault	0.30	-0.65(1)	-0.59	-1.24(1)
Murder & attempted	**-2.79***	-2.38 (1)	**-3.08****	-2.44 (3)
Robbery	-1.47	-1.99 (1)	-2.14	**-2.84 (1)***
Violence	-1.19	-1.75 (1)	-0.65	-1.30 (1)
Break & Enter	-2.57	**-2.75 (1)***	**-2.84***	**-3.26 (1)**** **-2.97 (2)****
Fraud	-2.52	**-3.00 (1)**** **-2.78 (2)***	-2.52	**-3.39 (1)**** **-3.11 (2)****
Motor Vehicle Theft	-1.53	-2.18 (1)	-1.51	-2.33 (1)
Theft-under	**-2.64***	**-2.88 (1)*** **-2.71 (2)***	**-2.71***	**-3.33 (1)**** **-3.20 (2)****
Theft-over	-1.87	-1.91 (1)	-1.87	-1.82 (1)
Critical Values ***p<0.01	-3.6289	-3.6353	-3.6289	-3.6353
**p<0.05	-2.9472	-2.9499	-2.9472	-2.9499
*p<0.10	-2.6118	-2.6133	-2.6118	-2.6133

Table 3.5: Cointegrating Regressions and Tests for Non-Cointegration Between Male Crime Rates and Unemployment

Male Crime Rates	All Male Unemployment		Total Unemployment	
	DF	**ADF(Lags)**	**DF**	**ADF(Lags)**
Assault	-1.67	-2.18 (1)	-1.23	1.83 (1)
Attempted Homicide	**-2.83***	**-2.77 (1)***	**-3.12****	**-3.31 (1)**** **-2.76 (2)***
Murder	-1.58	-1.85 (4)	-1.47	-1.64 (4)
Robbery	**-2.66***	**-3.34 (1)****	**-2.78***	**-3.68 (1)***** **-2.67 (2)*** **-2.84 (3)***
Violence	-1.80	-2.36 (1)	-1.36	-2.02 (1)
Break & Enter	-1.48	-1.34 (1)	-1.40	-1.32 (1)
Fraud	-1.50	-1.93 (1)	-1.30	-2.05 (1)
Motor Vehicle Theft	-0.10	-1.19 (3)	-0.02	-0.93 (4)
Theft-under	-2.38	**-2.77 (1)***	-2.44	**-3.17 (1)**** **-2.78 (2)***
Theft-over	-1.21	-2.13 (2)	-1.18	-2.05 (2)
Critical Values ***p<0.01	-3.6289	-3.6353	-3.6289	-3.6353
**p<0.05	-2.9472	-2.9499	-2.9472	-2.9499
*p<0.10	-2.6118	-2.6133	-2.6118	-2.6133

unemployment rates at lags (one or two years). "Murder & attempted murder" is affected simultaneously by a high unemployment rate. Theft-under and break and enter both exhibit simultaneous and lagged relationships with unemployment. Certain male crime rates also prove to produce a stationary residual series when regressed on unemployment rates. Male attempted murder, robbery and theft-under are all cointegrated with both unemployment rates. There are both simultaneous and lagged effects of unemployment on the violent crime rates of attempted homicide and robbery whereas only the lagged effects of unemployment act on male theft-under rates. Unlike the results for females, there is less indication that male property crime is impacted by the pinnacles and nadirs of the unemployment rate over the course of the series. Female results indicate that unlike males, additional female property crime rates (fraud and break and enter) are more closely related to the unemployment rate.

Sex-Specific Economic Impact on Crime Across Age Groups

With an initial indication that there are differences between the economic impact on male and female crime rates generally, a further exploration into the differences by age was undertaken. Tables 3.6 through 3.9 present the findings of cointegration tests between the rates of adults and juveniles (considered separately) by sex and the general and specific unemployment rates. At this point, it must be recalled that the stationarity tests (Dickey-Fuller test) caused some of the variable trends to be removed from the analysis. As we found in Table 3.1, all of the unemployment rates were determined to be integrated of order one *I(1)*. All of the adult female trends (excluding murder) are also *I(1)* allowing the full set to be tested for cointegration. Adult male violence was determined to be *I(2)* meaning it failed to become stationary until it was differenced twice therefore it could not be included in the analysis. Juvenile male and female murder rates and juvenile female theft-over were determined to be stationary at levels resulting in their exclusion. In these cases, a more appropriate statistical technique would be OLS with the possibility of including a lag of the dependent variable on the right hand side of the equation to adjust for serial correlation and prop up the unacceptable Durbin-Watson test

statistics. As was the case for adult females, murder in the juvenile categories is a very low number with rates that are *noisy* at levels. Thus, both juvenile murder and attempted murder for each sex were collapsed into the "murder & attempted murder" category which was integrated at order one (i.e. after first differencing).

Table 3.6 indicates that adult female rates of "murder & attempted murder", robbery, break and enter, fraud, motor vehicle theft, and theft-under are cointegrated with both the general and specific unemployment rates. Only

Table 3.6: Cointegrating Regressions and Tests for Non-Cointegration Between Adult Female Crime Rates and Unemployment

Endogenous Variables	Exogenous Variables			
Adult Female Crime Rates	**All Female Unemployment**		**Total Unemployment.**	
	DF	**ADF(Lags)**	**DF**	**ADF(Lags)**
Assault	0.42	-0.50 (1)	-0.52	-1.16 (1)
Murder & attempted	**-4.20*** **	**-3.15 (1)** **	**-3.60** **	**-3.06 (1)** **
		-3.01 (2) **		**-2.86 (2)* **
		-3.51 (3) **		**-2.98 (3)** **
Robbery	**-2.87* **	**-3.62 (1)** **	**-3.21** **	**-4.08 (1)*** **
		**-2.93 (2)* **		**-3.42 (2)** **
				**-2.75 (3)* **
				**-2.91 (4)* **
Violence	0.28	-0.57 (1)	-0.63	-1.25 (1)
Break & Enter	**-3.04** **	**-4.93 (1)*** **	**-2.85* **	**-3.69 (1)*** **
		-4.60 (2)* **		**-3.22 (2)** **
		-3.74 (3)* **		
		-3.17 (4) **		
Fraud	-1.73	**-2.92 (1)** **	-2.53	**-3.44 (1)** **
				-3.09 (2) **
Motor Vehicle Theft	**-2.66* **	**-3.89 (1)*** **	-2.39	**-3.51 (1)** **
		-4.47 (2)* **		**-3.05 (2)** **
		-3.21 (3) **		
		**-2.94 (4)* **		
Theft-under	-2.36	**-4.17 (1)*** **	**-2.71* **	**-3.46 (1)** **
		-3.56 (2) **		**-3.51 (2)** **
				**-2.78 (3)* **
Theft-over	-1.92	-2.00 (1)	-1.96	-1.88 (1)
Critical Values ***p<0.01	-3.6289	-3.6353	-3.6289	-3.6353
**p<0.05	-2.9472	-2.9499	-2.9472	-2.9499
*p<0.10	-2.6118	-2.6133	-2.6118	-2.6133

assault, violence and theft-over fail to indicate the presence of a cointegrating vector. Adult female fraud is the only cointegrated crime trend that shows only

Table 3.7: Cointegrating Regressions and Tests for Non-Cointegration Between Adult Male Crime Rates and Unemployment

Adult Male Crime Rates	All Male Unemployment		Total Unemployment	
	DF	ADF(Lags)	DF	ADF(Lags)
Assault	-1.62	-2.11 (1)	-1.15	-1.73 (1)
Attempted Homicide	**-2.97****	**-3.07 (1)****	**-3.38****	**-3.83 (1)***** **-3.18 (2)**** **-3.14 (3)****
Murder	-2.11	-1.83 (2)	-2.06	-1.78 (2)
Robbery	**-2.72***	**-3.41 (1)****	**-2.84***	**-4.06 (1)***** **-2.90 (2)*** **-3.00 (3)****
Break & Enter	-1.71	-1.73 (1)	-1.60	-1.80 (1)
Fraud	-2.19	-2.56 (1)	-2.11	**-2.85 (1)***
Motor Vehicle Theft	-1.75	-2.00 (1)	-1.64	-1.99 (1)
Theft-under	-2.57	**-2.99 (1)**** **-2.89 (2)***	**-2.77***	**-3.68 (1)***** **-3.63 (2)**** **-3.10 (3)****
Theft-over	-1.07	-1.78 (1)	-1.05	-1.75 (4)

Critical	***p<0.01	-3.6289	-3.6353	-3.6289	-3.6353
Values	**p<0.05	-2.9472	-2.9499	-2.9472	-2.9499
	*p<0.10	-2.6118	-2.6133	-2.6118	-2.6133

Table 3.8: Cointegrating Regressions and Tests for Non-Cointegration Between Juvenile Female Crime Rates and Unemployment

Endogenous Variables	Exogenous Variables			
Juvenile Female Crime Rates	Female (15-19) Unemployment		Total Unemployment.	
	DF	ADF(Lags)	DF	ADF(Lags)
Assault	-0.18	-1.13(4)	0.17	-0.57(1)
Murder & attempted	**-2.99****	-2.46(4)	**-3.37****	**-2.61(3)*** **-2.77(4)***
Robbery	-0.19	-0.41(1)	0.56	0.15(1)
Violence	-0.13	-1.04(4)	0.25	-0.49(1)
Break & Enter	**-2.66***	**-2.64(1)*** **-2.64(2)***	**-3.09****	**-3.32(1)**** **-3.39(2)**** **-3.05(3)****
Fraud	-1.64	-1.94(4)	-2.20	-2.13(1)
Motor Vehicle Theft	-1.22	-1.73(2)	-0.99	-1.70(1)
Theft-under	-1.46	-1.96(1)	-2.11	**-2.70(1)***

Asterisks indicate the rejection of the null hypothesis of non-cointegration.
*p<0.10 **p<0.05 ***p<0.01. QMS EViews produced the critical values for the DF and ADF tests for a sample size of 36. Test statistics were produced using *Estima's* RATS. Numbers in parentheses indicate lag at which the t-statistic becomes significant for the test.

Table 3.9: Cointegrating Regressions and Tests for Non-Cointegration Between Juvenile Male Crime Rates and Unemployment

Juvenile Male Crime Rates	Male (15-19) Unemployment		Total Unemployment	
	DF	ADF(Lags)	DF	ADF(Lags)
Assault	-0.97	-1.51(1)	-0.32	-1.25(1)
Murder & attempted	-2.38	-2.23(2)	-2.41	-2.23(2)
Robbery	-1.64	-1.91(1)	-0.90	-1.38(1)
Violence	-1.05	-1.61(1)	-0.41	-1.37(1)
Break & Enter	**-2.75***	-2.42(1)	**-3.13****	**-3.02(1)****
Fraud	-1.68	-2.32(1)	-1.92	**-2.96(1)****
Motor Vehicle Theft	**-2.61***	-2.57(3)	**-2.64***	**-2.68(1)***
Theft-under	-2.10	-2.23(1)	-2.39	**-2.93(1)***
Theft-over	-1.82	-1.81(2)	-1.94	-2.13(3)

Critical	***p<0.01	-3.6289	-3.6353	-3.6289	-3.6353
Values	**p<0.05	-2.9472	-2.9499	-2.9472	-2.9499
	*p<0.10	-2.6118	-2.6133	-2.6118	-2.6133

Asterisks indicate the rejection of the null hypothesis of non-cointegration.
*p<0.10 **p<0.05 ***p<0.01. QMS EViews produced the critical values for the DF and ADF tests for a sample size of 36. Test statistics were produced using *Estima's* RATS. Numbers in parentheses indicate lag at which the t-statistic becomes significant for the test.

lagged effects (one and two years) of unemployment acting on its variation through time. All of the other cointegrated relationships show a contemporaneous and lagged effect of unemployment on adult female crime rates. It is noteworthy that with the exception of theft-over, all of the property offenses are cointegrated with unemployment. Assault, the largest category making up violent crime, as well as total violent crime did not prove to be cointegrated with unemployment. The more serious offenses of robbery and "murder & attempted murder" did prove to be related to unemployment in some way.

Adult male crime rates for attempted murder, robbery, fraud, and theft-under also show some evidence of cointegration (Table 3.7). Both of the cointegrated violent crimes (attempted homicide and robbery) are related to unemployment both simultaneously and at lags. Fraud is only related to unemployment at a one-year lag while theft-under is related to unemployment *for the most part* at lags of one to three years.

Juvenile female break and enter, theft-under and "murder & attempted murder" are cointegrated with unemployment. In table 3.8, "murder & attempted murder" shows stronger simultaneous effects of unemployment but still some smaller three and four year lagged effects. Break and enter exhibits strong simultaneous and lagged effects of unemployment whereas theft under is affected by general unemployment at a one-year lag.

Table 3.9 indicates a somewhat different set of cointegrated vectors produced between 15-19 year old male unemployment and juvenile male crime rates. We can see that there is cointegration of some form between break and enter, fraud, motor vehicle theft, and theft-under crime rates for juvenile males. No violent offenses committed by juvenile males were found to be cointegrated with either unemployment rate. For the most part, the cointegrated property offenses are affected more by the lagged unemployment rate at a lag of one year. Only B & E and motor vehicle theft demonstrate change due to the simultaneous effects of unemployment but these two crimes also have significant one-year lagged effects as well.

Note that four of the five juvenile male property crime categories and half (two of four) of the juvenile female property crimes show a cointegrated relationship with unemployment. For adults, only two of the five male property crimes and four-fifths of the adult female possibilities exhibit cointegration with unemployment. It appears that the relationship between unemployment and crime rates is more similar between juvenile males and adult females than across same-aged sex categories. Some possible explanations for this finding will be made later in the chapter.

To summarize, the results of economic variables on various crime rate patterns are intriguing statistically but cumbersome and perplexing conceptually. Briefly, we have uncovered that unemployment causes "murder and attempted murder" among females and males generally, adult males, adult females and juvenile females but not juvenile males. Unemployment causes break and enter among juveniles of both sexes as well as adult females, but not adult males. Every group is compelled to commit theft-under as a result of economic hardship caused by unemployment. But no group commits theft-over despite the presence of the same economic rationale. Adult robbery is

cointegrated with unemployment but juvenile robbery is unrelated to the jobless rate. Assault, the largest violence category is never caused by unemployment. There are many theories in criminology able to reconcile the complex interrelationships contributing to crime causality but none which would be consistent with these specific predictions.

Cointegrated Relationships Between Demography and Crime

Throughout the text of this thesis, there has been considerable focus on the impact of age as a predictor of individual crime in addition to aggregate age composition as a predictor of aggregate crime rates. The tried and trusted relationship held out by Gottfredson and Hirschi (1990) among others suggests that the age-crime curve is the same over different national data sets, historical epochs and both sexes. These points are not in dispute and are of no real consequence to this thesis. What is of concern is another assertion generally attached to the age-crime discussion. It is contended (usually without dispute), that the signature of the curves for both violent and property crime are remarkably similar. It is suggested that property crime rates spike sharply to a crest in the late teens and early twenties and then drop away quickly. The age-crime curve for violent crime is believed to crest later (early to mid-twenties) and then to decline somewhat less quickly than the property curve. All the while, the general signature of the curves is thought to remain similarly skewed with age-property crime distribution being *more* leptokurtic with a relatively *small variance* when compared to violent crime.

We believe this to be overly simplistic, at least for the Canadian case. This belief stems from the 1997 age-crime distributions presenting all property and all violent offenses by age on two separate bar graphs (refer back to figures 2.15 and 2.16 on page 68) reproduced from Juristat (Statistics Canada Catalogue No. 85-002XPE, Vol.18, No. 11: p.12). From the discussion of figure 2.15, recall that the age distribution for property crime is actually a gradually declining and widely distributed trend. The mean age of the property offender in Canada in 1996 and 1997 was reported to be 21 years. This mean seems to confirm the orthodox belief about the distribution. But, by studying the figure, we can see that the range of ages contributing 2% or more toward the total

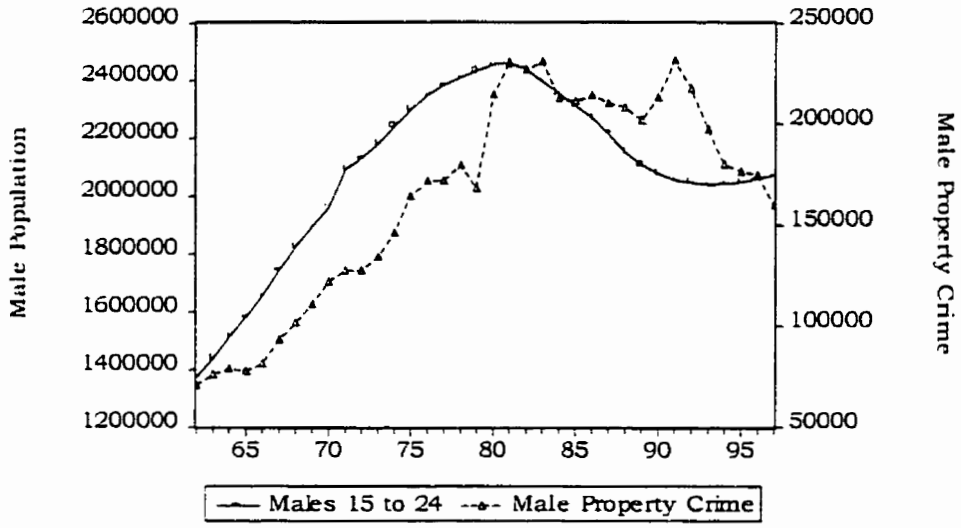
property crimes (bearing in mind that the maximum contribution, at 7%, is 16 years) is from 12 to 36 years. Even granting that there is a clear tendency toward those persons in their late teens and early twenties, the curve does not merely fall away in a steady downward fashion but rather it plateaus for a considerable distance. Prompted by the presentation of this one year age-property crime distribution, the evidence of the existence of a clear mode is irrefutable. Still the longer than expected tail and the height of the downward trend considerably above zero on the y-axis leads us to doubt whether the mean is actually the best way to understand the demographic impact on property crime.

Because the signature of the numbers of persons in each single age group plotted through time is a gentle curve upward and a similarly gradual decline, it becomes clear that there are no individual age curves which could be fit to a property crime trend. Based on the logic of the last paragraph, it is plausible to conceive of more than one non-adjacent age (in this case two) being added together and their joint trend over time being plotted as one line. This means that the two summed ages serve as proxies for the variability in criminal participation across age ranges. To even speculate about a cointegrated relationship we know that there must be similarities in signature across the trends.

Figure 3.2 attempts to underscore the effects of demography on crime. Based on a publication by the Fraser Institute (also available at www.fraserinstitute.ca/critical_issues/1998/crime/fear.html) which asserted that demographic age structure (those aged 15 to 24) tracked property crime offenses extremely well, we have augmented the graph by adding several years of data. If the assertion was made in 1989 that the number of persons aged 15-24 explained property crime, there would have been reasonable visual grounds for testing the hypothesis. But, we can see that there is a clear deviation for several years in the early 1990's which age structure, as defined here, can not explain. Note that in this figure there is some visual similarity between the demographic trend line and the crime trend. But, because the age distinctions through time are generally gradual curves which peak and decline, the summation of several *contiguous* years only produces a more gradual curve with

higher values on the y-axis. Clearly, the second peak in 1992 can not be explained using the same predictor (males 15 to 24). Furthermore, this demographic trend includes only 15-24 year old persons which we now suggest excludes much of the population at the older ages who are actually involved in substantial amounts of crime (figure 2.15, p. 68).

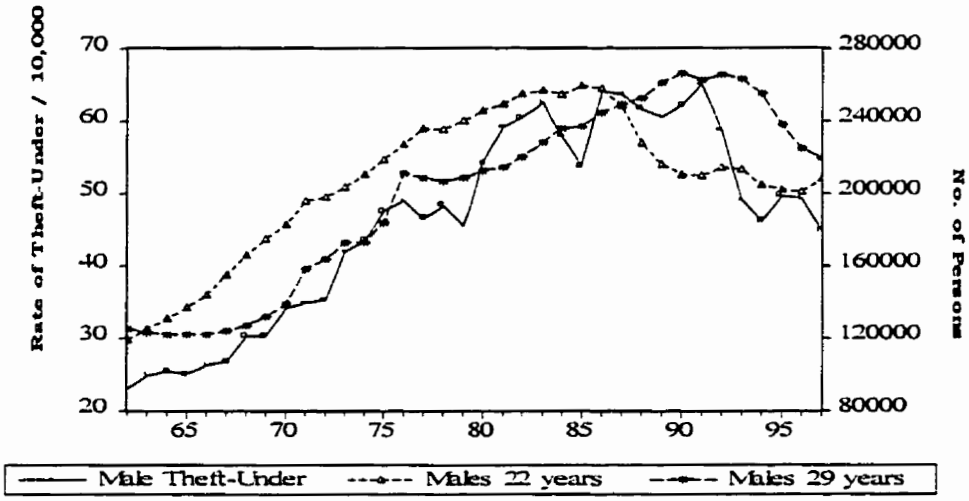
Figure 3.2: Males Aged 15 to 24 and Male Property Crime Offenses



Conceptually, the addition of two ages survives initial objections by noting that the criminal activity of those persons above the mean of 21 is at least equally important in understanding which persons are responsible for either violent or acquisitive criminal activity. To reiterate the accompanying caption in the same Juristat publication cited above, ". . . 4 in 10 persons accused of property crime were aged 13 to 20 years. . ." clearly begging a question of the orthodox believers in simple age-crime relationships—what about the other 60%? We clearly see from figure 2.15 that they are not merely clustered between ages 21 and 24 as the Fraser Institute suggests.

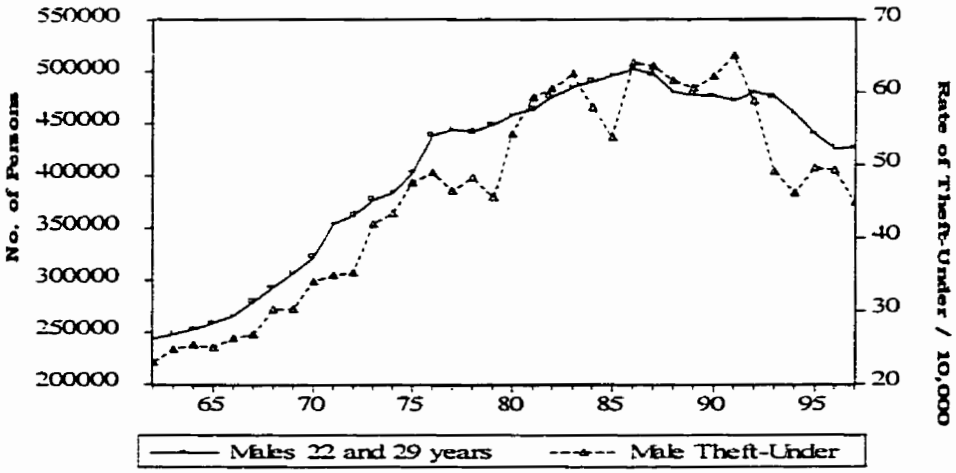
To resolve the disparate signature contention which clearly survives when matching one single age category to the property crime trends, an innovative solution was developed. Note that figure 3.3 produces the age

Figure 3.3: Male Theft Under and Males Aged 22 and 29 (separately)



distributions for all males in Canada of ages 22 and 29 in addition to the rate of male theft-under over the entire 1962-1997 series. Contrasting figure 3.3 to 3.4, we are struck by the striking similarities between the trend for theft under and the new summative age trend. Arguably, we have discovered the necessary similarity of signature which remained elusive with the use of single ages.

Figure 3.4: Male Theft Under and Males Aged 22 and 29 (combined)

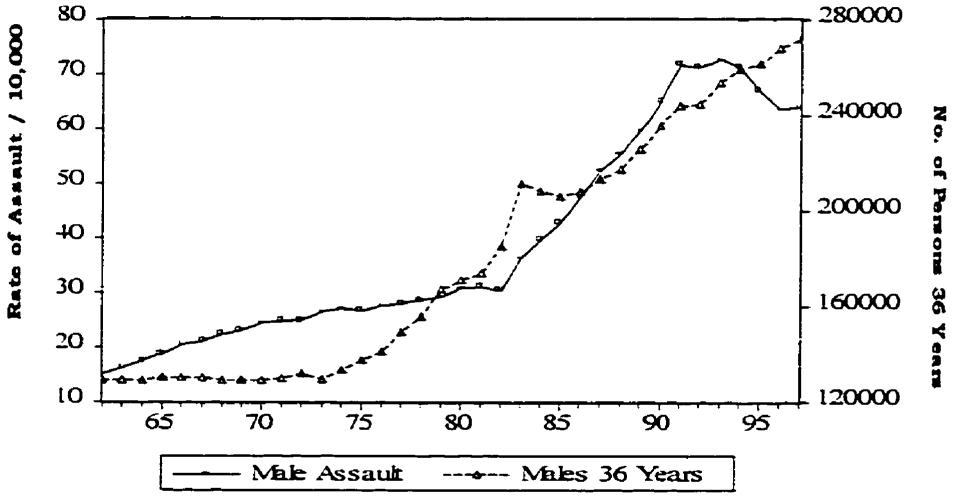


For violent crimes, clearly the signature is different. Violent offense series, either as a whole or considered specifically possess little to none of the two headed signature that most property crimes have revealed. On the

contrary, these offenses show themselves to possess long and slow upward climbs from 1962-1990 before turning downward. We have already established cointegrated relationships between males and females, thereby reassuring ourselves that the patterns are stable across the sexes. Juristat (Vol.18, No.11: 12) presents the companion figure to the property crime-age distribution discussed above (reproduced herein as figure 2.16, p.68). Regarding violence offenses, we contend: (a) that the conventional wisdom stating that violence offenses are committed only slightly later in life and decline only slightly slower than property crime than the latter is unfounded, and (b) that the mean age again obscures the older ages of participation because the distribution is approximately bimodal and very wide (large variance) indicating participation into relatively old age. The reported mean of 29 for all violent offenses is no doubt accurate but because the figure includes both males and females together, it is reasonable to assume that the means for each sex would not necessarily be equal to the grand mean and in fact the mean is being prejudiced by the participation of the younger age groups.

Consider now the signature and the distribution of male assault over the series and suppose that the mean of 29 is unrealistically low thereby nullifying the effects of much of the older offenders. If, for instance, an age category

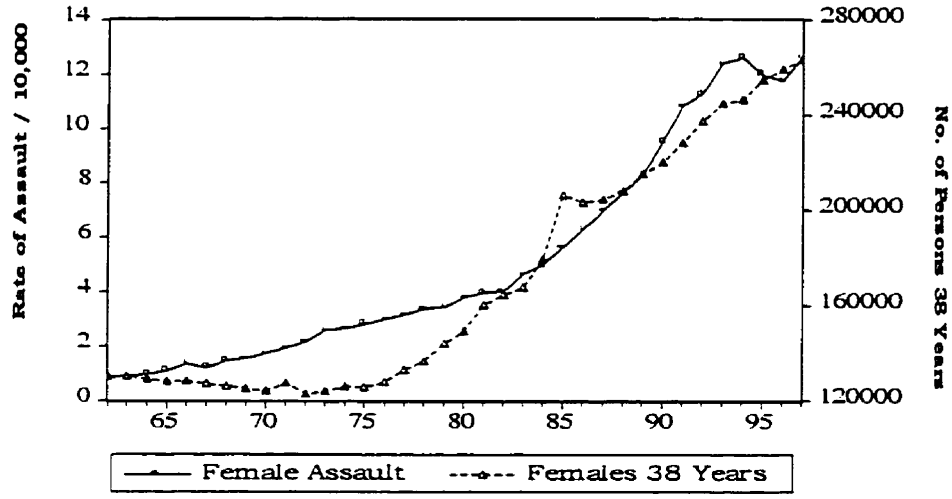
Figure 3.5: Male Assault and Males Aged 36 Years



demonstrated itself to be cointegrated with violent crime despite the fact that the age is older than the mean, such a finding would make sense.

Furthermore, considering that between 1962 and 1997, there has undoubtedly been considerable variation in the ages at which persons become involved in crimes of both types (though more strikingly for crimes of violence),

Figure 3.6: Female Assault and Females Aged 38 Years



it is conceivable that the 1997 age-crime patterns may also present different shapes if they were available through the full series. Figure 3.5 presents the series of males aged 36 through the period under study overlaid with male assault over the same period. Figure 3.6 provides the matching graph of female assault and females aged 38. Notice that the trends intuitively move together visually and prove statistically similar through the tests for cointegration.

Because the identification of a summed age for property crime and individual ages for violence is necessarily speculative, some explanation of the process used to arrive at them is warranted. To suggest that these values came exactly from a government statistics source book would be false. The 1997 Canadian Crime Statistics Catalogue (Statistics Canada-85-205-XPE) provides a table of crime specific criminal activity by age group and sex. The information is instructive in the sense that it confirms our use of ages older than the norm. Whereas the general understanding of age and crime would restrict plausible ages to teenagers and those in their early twenties, this table indicates that

there are good reasons for including older persons in a demographic analysis of crime (p. 61). For example, male non-sexual assault committed by juveniles (aged 12-17) comprises 14.7% of the male total but males 30-34 years commit 14.9% of assaults. The juvenile category captures a range of six years of offenders (age 12-17) while the latter range captures only five years suggesting that juveniles are not the greatest physical threat but rather it is males almost twice their age. Information from the US also indicates that the average ages of criminals is substantially higher than commonly assumed.

The presentation of the distributions in the Juristat Bulletins for 1996 and 1997 were the first of their kind in that publication and no others have been uncovered for Canada at any other point in the series. The two available annual figures were virtually identical by type and with that in mind, we are left to try to coax the long term information from the data being analyzed. With the ability to derive some hunches based on merely examining the activity of the trends for the age categories over the series, coupled with an understanding of what ages should even be considered, the task of testing these ages for stationarity began.

Each individual age was tested for stationarity and most ages proved to be *I(1)*. Unfortunately, series for males 17 through 24 proved to be *I(0)* whereas all crime rates were found to be *I(1)*. Knowing that the testing of two variables which become stationary at different levels is in violation of the assumptions of cointegration, these individual ages could not be used. For violence, this proved to be inconsequential because the likely ages were considerably older than 24 years. For property crime, the graphical presentation of the crime rates and age curves, in addition to the argument above, suggested that there exists both young and older age components to the overall crime prone demographic trend. With age variables 17-24 unusable for males, *individually that is*, several combinations of ages were examined for their proximity in form to the property crime being addressed. Next, upon identifying common signatures such as that found in figure 3.4, stationarity tests were undertaken. Table 3.10 provides an abridged view of the sort of testing which was undertaken in an effort to determine that these trends (males only are presented but tests were done for both sexes) were acceptable for use with crime rates integrated at order one.

From table 3.10, we can see that four (of the 10 visually interesting possibilities) age summation variables are presented for testing. Exactly as was done in Table 3.1, the Dickey-Fuller and Phillips-Perron Tests were performed with the same variations (i.e. constant, trend, differenced). In the first example (Age 22 + Age 30) has a Dickey-Fuller statistic (with constant/at levels) in the second column which would indicate stationarity. In fact, all four combinations presented here possess, at first glance, stationarity at levels. Secondly, the Phillips-Perron test (with constant/at levels) was performed for the same confirmatory reasons mentioned regarding table 3.1. Remarkably, this test indicated that none of the four combinations were stationary even at the 10% level. With these contradictions in mind, the possibility of these variables being trend stationary was explored in the third column and in fact the DF test statistics were all positive in sign and clearly not stationary with a constant and a trend. Finally, the opposing findings in the first three tests suggested the necessity of the final two tests which were the DF and the PP

Table 3.10: Dickey-Fuller (DF) and Phillips-Perron (PP) Tests for Non-Stationarity

Male Age Combinations		(DF) Test at Levels with Constant	(DF) Test at Levels with Both Constant & Trend	(PP) Test at Levels with Constant	(DF) Test at First Difference with Constant	(PP) Test at First Difference with Constant
Males 22 and 30*		-2.90	+1.65	-2.28	**-2.81***	**-2.77***
Males 20 and 30		-3.15	+1.19	-2.48	-2.64	-2.54
Males 20 and 29		-3.20	+1.12	-2.44	-2.41	-2.30
Males 22 and 29*		-2.85	+1.32	-2.25	**-2.79***	**-2.73***
Critical Values	α<.01	-3.6289	-4.2412	-3.6289	-3.6353	-3.6353
	α<.05	-2.9472	-3.5426	-2.9472	-2.9499	-2.9499
	α<.10	-2.6118	-3.2032	-2.6118	-2.6133	-2.6133

Test statistics for the above tests were produced using Estima's RATS and EViews from QMS. Critical values for the tests were provided by EViews based on Mackinnon (1991) for a sample size of 36. Critical values for the 1%, 5% and 10% are provided due to the stringent nature of the test. Note that at first differences only Female Fraud and Male Violence are significant at the more relaxed level of significance.

tests at first differences with a constant in the equations. After these tests, series combinations which exceeded at least the 10% critical value for both of the tests were retained and declared to be *I(1)* while the others were discarded as unusable. In the four examples presented above, the first and fourth

combinations pass the tests but both the second and third examples have either one or both of the test statistics unable to satisfy the 10% level of significance. In total, ten combinations were tested for males with six surviving to be tested further . For females, ten combinations were tested resulting in the retention of only four combinations.

Table 3.11: Diagnostic Tests Justifying the Selection of Specific Ages as Proxies for Demographic Effects on Crime

	OLS Regression Model				
Variables	**1**	**2**	**3**	**4**	**5**
Males 22	.000291*** (.0000)		.000131*** (.0000)		
Males 29		.000243*** (.0000)	.000164*** (.0000)		
Males 22 & 29				.000150*** (.0000)	.000068*** (.0109)
Male Theft Under Rate (1 lag)					.519803*** (.0018)
Constant	-13.95	-2.31	-13.64	-14.64	-5.22
R^2	.755	.851	.915	.913	.931
Durbin-Watson	.379	.597	.983	.967	1.55

To illustrate the process of age selection, table 3.11 provides the results of five simple OLS regressions for the example of the summed variable "males aged 22 & 29". The choice of these ages in the combination was the result of visual fitting of the individual ages to the trend line for property crimes generally. Consistently, the combination showed itself to be similar enough to the crime trends to warrant investigation. As described earlier, the use of individual ages for property crimes results in very large error terms because of the *complex* distribution of property crimes over the series and the *simple single age* trends. Because of the initial promise shown by these ages (combined together), quantification of their fit to the property crime trend (in this case theft under) was undertaken through a series of regressions.

From table 3.11 (model 1), the R^2 of 75.5% and the very high level of significance of age 22 is encouraging. Model 2 indicates that individually, the

number of males aged 29 explains 85.1% of the variation in male theft under. The multivariate regression in model 3 shows both variables remain statistically significant and the explained variation climbs to 91.5%. Next, model 4 provides the results of the regression of male theft under on the summed variable "males 22 & 29" and again the significance level is well beyond the 1% level of rejection. It should be noted that in these four models the Durbin-Watson test statistics are clearly unacceptable due to the obvious presence of serial correlation in the variable(s) thus making the R^2 values unrealistic and misleading.

In model 5, the addition of a lag of the dependent variable as a predictor (VAR technique) with the summed age variable returns the Durbin-Watson statistic to a fairly respectable 1.55 and the explained variation rises to 93.1%. These models are not meant to convince the reader that more than ninety percent of male theft under is the result of the sum of males aged 22 and 29 over the series. On the other hand, the existence of significant effects of both of the ages chosen for combination (individually, together, and summed) provides reasonable evidence for their summed total to be used as a predictor of property crime, rather than a single age. Also, it is clear that the R^2 changes from models 1 and 2 to model 3 suggest that the two variables share much of their explanatory power, but compared to model 3 there is still a net increase of 6.4% over model 2 and 16% over model 1. It is reasonable to wonder why we do not merely use the ages individually. Again, because of the *I(0)* characteristic of males aged 22, we would be prevented from using this age in any cointegration analysis thereby eliminating it as an explanatory predictor. Age 29 could be used alone but it would be less effective and theoretically misleading to eliminate younger ages (where the clear mode exists).

Upon ascertaining the integration order of the combined ages for both males and females, the tests for cointegration between these <u>new</u> (summed age) variable series and property crimes by sex were performed. The results in table 3.12 below indicate the successful combinations resulting in positive confirmation of cointegration between male and female ages and specific crimes. Regarding violent crime, it appears that the female and male ages proving to be cointegrated with assault specifically and violence generally are

approximately the same. Still, males at younger ages show cointegration with violence and assault over the cointegrated ages for females. Also, males aged 26, 27 and 29 are cointegrated with robbery while no female ages proved to be cointegrated. Females aged 24 to 30 are cointegrated with "murder & attempted murder" while no male ages showed similar relationships. For now we can only say that the results for violence and assault were expected

Table 3.12: Summary of Cointegration Results for Male and Female Crime (Violent and Property) on Age Structure

Crime Rates	Male Ages	Female Ages
Violent Crimes		
Violence (All)	33-->39♦*	37-->39♦*
Assault	27*, 31-->39♦*	37-->39♦*
Murder plus Attempted	None	24-->30♦*
Robbery	26, 27, 29*	None
Property Crimes		
Robbery	19 & 29* 21 & 29* 21 & 30* 22 & 30* 22 & 29*	None
Fraud	None	None
Theft Over	None	None
Motor Vehicle Theft	None	None
B & E	None	22 & 30* 20 & 30* 20 & 28* 19 & 29*
Theft Under	19 & 29* 21 & 29* 21 & 30* 22 & 30* 22 & 29* 20 & 28*	22 & 30* 20 & 30*

Only cointegrated ages are included in this table.
♦ indicates that each age in the range (i.e. 31, 32, 33...) was tested.
*** denotes a significant test for cointegration (at p<.05 or better).**
"None" indicates no significant Age-Offense cointegration tests.

to be the same and robbery can be theoretically argued, but the results for the most severe violent crime (murder) are anomalous.

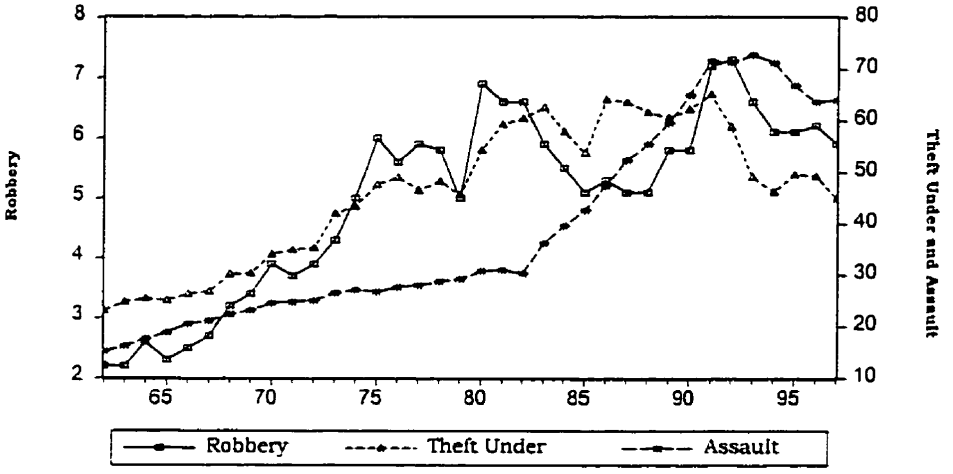
Results for property crimes (table 3.12 lower panel) also failed to provide clear answers. For both sexes, the use of combined ages tested as cointegrated with theft-under. Female combined ages were discovered to be cointegrated with break and enter while male combined ages were predictive of robbery through the cointegrating regression test. Neither of the sexes demonstrated age structure relationships with motor vehicle theft, theft over or fraud. A possible reason for the recurring insignificance of theft-over in all of our tests could lie in the fact that the signature for this variable is very erratic with steep climbs and descents. From a criminogenic perspective, this wild activity by the trend could be interesting were it not for the fact that the flash points of change in the trend are easily explained using the years of the definitional change of the offense. As the upper limit (in dollars) of theft-over changed, the number of offenses dropped immediately and sharply. As more expensive goods become available, to buy or to steal, the trend can be seen to climb quite steeply until the next change in the definition of the category when the cycle repeats itself.

Motor vehicle theft tends to be an activity of the young and fraud is notoriously an activity perpetrated by older persons. For this reason, the generic combined ages selected for property crimes perhaps failed to meet the early and late peaks in the fraud distribution. Perhaps 16 and 23 would be more suitable for motor vehicle theft while 24 and 35 may be superior for fraud. Although interesting and worthwhile questions abound, this thesis is satisfied that the largest single categories of violence and property can be addressed.

Notice the presence of robbery in both the violent and property panels of table 3.12. Reasons can be suggested for the demographic contribution toward break and enter for females and not for males and the opposite regarding demographic composition and robbery where males show a relationship and females do not. Briefly, Easterlin's line of reasoning may be that the increase in numbers in this generated cohort of combined ages can result in economic competition in the labour force causing anomic motivation toward crime. Furthermore, the reasons for the differing responses to the stimulus of economic strain may lie in the inherent nature of males and females to respond

in either a subtle (break & enter) or an aggressive (robbery) mode of response (Broidy and Agnew, 1997). Conceptually, both crimes have the potential to solve the economic tension but they are markedly different in the method used to acquire stolen property.

Figure 3.7: Male Crime Rate Trends (1962-1997)
Robbery, Theft Under, Assault



Use of a visual example is helpful in understanding the dual nature of robbery. It is not our purpose to re-define robbery as a property crime but the nature of the act and the behaviour of the trend over time prompts some attention. Because robbery is theft with force or threat of force, victims would surely hesitate to merely label such acts property offenses. Still, the motivation in robbery is acquiring money or property, and violence is either a planned or unplanned side effect. Violence expedites theft in a confrontation. The threat of force intimidates victims into relinquishing their property. As such it is instructive to consider figure 3.7 which provides trends for theft-under, robbery and assault on a single graph. Notice how robbery possesses many of the characteristics of theft, as indicated by the multi-headed signature. Also, the rate of ascent indicates some slight similarity to violent crime. For reasons given earlier, the smooth single age signatures and the relatively complex robbery signature would hardly qualify as the optimal cointegration candidates (although some single ages do prove to be cointegrated). Conversely, the use of

summed ages, as was shown earlier, approximates the shape of property offenses. Combinations of summed male ages were tested and many of the tests confirmed cointegrated relationships with robbery.

To confirm the similarity of robbery to other property offenses, an error correction model including demography, unemployment and robbery was tested which indicated that the addition of unemployment (our measure of economic strain) is warranted. Results indicate that an explanation of robbery does in fact benefit from the inclusion of an unemployment measure in the equation. The complete error correction equation for robbery as well as its interpretation will be presented in the following section. Also, the results of error correction models for the largest male property and violent crimes (theft under and non-sexual assault respectively) will be presented. For the sake of simplicity, only the results for males will be provided here but results for females demonstrate that the same models are useful in understanding variation in the female crime rates.

Error Correction Models

To test the time series relationships between demography, economy and crimes in the most parsimonious and unambiguous manner, the error correction process was selected. As described in the previous chapter, an error correction model (ECM) allows for the use of unaltered time series and also the addition of exogenous predictors both at levels and at lags to explain the long-term and short-term dynamics of the series. For the following analyses, no more than three lags of the exogenous predictors were included in the model because of the increasingly speculative and imprecise comprehensibility of effects more than three years previous. The first model is that of male robbery. As alluded to earlier, the male robbery trend behaves much like other property offenses with only a slight resemblance to violent crimes such as assault. The following tables summarize the basic error correction models (I), the full models (II) and the reduced form models (III) for male robbery, theft under and assault.

Table 3.13 (model I) indicates that the error correction term ECT alone is significant at the 5% level and accounts for 13.2% of the variation in male robbery. Model II (R^2 =0.485) includes the ECT as well as differenced robbery

lagged (1 to 3 lags) and simultaneous male unemployment as well as three lagged values of differenced male unemployment. The third model (III) is pared down to include only those three predictors which proved to be significant at the α=.10 level or better in model II. Based on the acceptable Durbin –Watson

Table 3.13: Error-Correction Models for Male Robbery, Demography (Males 22 & 29) and the Rate of Male Unemployment

Exogenous Variables	*Endogenous Variables*		
	Model I	**Model II**	**Model III**
	Male Robbery Rate	**Male Robbery Rate**	**Male Robbery Rate**
ECT_{t-1}	-0.302** (.032)	-0.296* (.098)	-0.296** (.041)
ΔUnemployment		0.275*** (.007)	0.261*** (.000)
$\Delta Unemployment_{t-1}$		-0.237** (.048)	-0.143* (.088)
$\Delta Unemployment_{t-2}$		0.023 (.827)	
$\Delta Unemployment_{t-3}$		-0.068 (.496)	
$\Delta Robbery_{t-1}$		0.113 (.598)	
$\Delta Robbery_{t-2}$		-0.073 (.749)	
$\Delta Robbery_{t-3}$		0.251 (.211)	
Constant	0.101	0.075	0.098
Akaike Criterion	-41.6	-38.3	-49.1
Adjusted R^2	0.132	0.485	0.421
Durbin-Watson	1.87	2.05	1.84

* p<.10 **p<.05 ***p<.01

statistic[15] and the cues provided by the value of the Akaike Information Criterion (AIC) which recommends the selection of the model with the lowest AIC, model III is preferred. In model III, the male unemployment rate simultaneously, and at the first lag are both statistically significant. This indicates that unemployment for males contributes to the amount of male robbery in any given year, as does the unemployment rate in the previous year. More importantly, the ECT is statistically significant with a value of –0.296 and the explained variance is 42.1%. Substantively, the ECT can be interpreted as the amount, on average, that the trend for robbery recovers toward equilibrium with demography in any given year. Recalling that cointegration does not imply

[15] The Durbin –Watson critical value for a series size of forty observations (N=40) and three regressors (k=3 other than the constant) is 1.60 at the 5% level (Wonnacott et al., 1970: 428).

perfect equilibrium but rather an elasticity of sorts between the two trends, it would take 3.37 years for the trends to return to an equilibrium relationship.

Table 3.14 provides the same three types of error correction models for male theft under regressed on male unemployment and lagged theft under values. In this table, model III is again preferred because of the relatively low AIC and the acceptable Durbin-Watson statistic. Moving across the table, we see that model I explains 16.5% of the variance with only the ECT used as a

Table 3.14: Error-Correction Models for Male Theft-Under, Demography (Males 22 & 29) and the Rate of Male Unemployment

Exogenous Variables	*Endogenous Variables*		
	Model I	**Model II**	**Model III**
	Male Theft Under	**Male Theft Under**	**Male Theft Under**
ECT_{t-1}	-0.410** (.016)	-0.707*** (.002)	-0.651*** (.000)
ΔUnemployment		1.294** (.029)	1.080** (.034)
$\Delta Unemployment_{t-1}$		-0.157 (.792)	
$\Delta Unemployment_{t-2}$		-1.472*** (.009)	-1.387*** (.005)
$\Delta Unemployment_{t-3}$		-0.000 (.999)	
$\Delta Theft\ Under_{t-1}$		0.311 (.082)	0.255* (.101)
$\Delta Theft\ Under_{t-2}$		-0.024 (.792)	
$\Delta Theft\ Under_{t-3}$		0.277 (.095)	
Constant	0.678	0.168	0.417
Akaike Criterion	93.7	79.6	76.9
Adjusted R^2	0.165	0.595	0.537
Durbin-Watson	1.48	1.95	1.73

* p<.10 **p<.05 ***p<.01

predictor. The full model (II) has an R^2 of 59.5% and indicates the significant explanatory power of the ECT, simultaneous and two-year lagged unemployment and the one-year and three-year lagged values of theft under. Refering to the reduced model III, we can state that demography clearly has an effect on theft under as indicated by the significant error correction term. The ECT value of –0.651 means that every year the value of theft under corrects 65.1% of its deviation away from an equilibrium relationship with males aged 22 & 29. Thus, the offense rate returns to equilibrium relative to demography every 1.53 years. Furthermore, unemployment in any given year significantly and directly influences the rate of theft under that year, as does the rate of

unemployment two years earlier (only inversely). The significant result for the lagged dependent variable indicates that the level of theft under from one year has an effect on the number of offenses in the following year. This *stickiness* of the offense rate from year to year is not merely the result of serial correlation as this problem has been addressed through the use of an ECM and careful consideration of the Durbin-Watson statistics. It is likely more due to the presence of the same criminal actors in the population from one year to the next. Again, aggregate data makes this interpretation speculative but plausible.

Changing the focus to a purely violent crime, the final table presents the three error correction models for male assault. Again, based on the lowest AIC

Table 3.15: Error-Correction Models for Male Assault Rate, Demography (Males 36 Years) and the Rate of Male Unemployment

Exogenous Variables	***Endogenous Variables***		
	Model I	**Model II**	**Model III**
	Male Assault	**Male Assault**	**Male Assault**
ECT_{t-1}	-0.102 (.162)	-0.212 (.854)	-0.124** (.043)
ΔUnemployment		0.008 (.980)	
$\Delta Unemployment_{t-1}$		0.287 (.366)	
$\Delta Unemployment_{t-2}$		-0.244 (.445)	
$\Delta Unemployment_{t-3}$		-0.337 (.303)	
$\Delta Assault_{t-1}$		0.367* (.056)	0.596*** (.000)
$\Delta Assault_{t-2}$		0.243 (.255)	
$\Delta Assault_{t-3}$		0.324 (.147)	
Constant	1.418	0.088	0.604
Akaike Criterion	61.1	48.01	46.3
Adjusted R^2	0.058	0.569	0.415
Durbin-Watson	0.84	2.16	2.29

* p<.10 **p<.05 ***p<.01

value, model III is selected for interpretation. The value of the ECT (–0.124) suggests that the equilibrium relationship is corrected by 12.4% each year meaning that almost nine years is required for the assault trend to return to equilibrium with males aged 36 years. This low ECT and the long period required to correct back to equilibrium suggests a smaller effect of age on assault. Unemployment has no effect on the rate of assault neither simultaneously nor at lags. Last year's rate of assault does prove to have an

effect on this year's rate with a highly significant coefficient adding 35.7% of the variation explained to the final model. Again, because of the safeguards against serial correlation (Durbin-Watson = 2.29) and the acceptable test statistics, the lagged effect of assault on current assault can not be discounted as a statistical artifact. Again, the explanation of persistent violent tendencies among offenders may shed some light on the apparent inertia in the rates from year to year.

It should be noted that in each of the above three tables, the preferred models were not selected for their R^2 values but rather were trimmed of all non-significant predictors. In every case the explained variation is greater for the full model (II) but the value is being propelled by the large number of influential, although non-significant (at $p<.05$) variables. Furthermore, identical models were estimated for the same female offenses and the results (not presented) indicated that female demography (aged 22 & 30) and female unemployment had very nearly the same impact on pure female property crime (theft under) and the *hybrid* category of robbery. Also, females aged 38 and female assault in the preceding year proved influential on female assault arrests. Understanding that the error correction techniques are somewhat different from OLS regression in the way that models are specified, it should be noted that the final model specification (with the possibility of lagged values proving significant) is no less credible than a traditional model where multiple predictors are left to prove their explanatory power. These *lagged values are conceptually parallel to different variables* and their *effects at lags may occur for different reasons* than at levels. This is merely a better way of estimating multiple lagged effects while minimizing the time series concern of serial correlation and maintaining the integrity of the trend's movements (rather than differencing). It also allows for the modeling of lagged effects of theoretically compelling variables which may prove to be significant, even in different directions, over the lags.

Discussion and Interpretation

At the inception of this research, the purpose was a test of the convergence hypothesis which suggested that females were becoming more criminal over time and were in effect gaining on males in participation in

property and violent crime. The findings reported early in this chapter (table 3.2) demonstrate that, with the exception of fraud, theft over, motor vehicle theft and break and enter, females are not varying their participation in crime relative to males. Also, it was demonstrated that for those crimes that were not cointegrated, the pattern of the trends indicate that female participation was not, and indeed is not, generally accelerating at a rate higher than that of males. Rather, the female rates were decelerating more slowly. Technically, this is also a convergent trend, but not in the sense that Adler (1975) implied. It can be said unequivocally that the *relative levels* of male and female participation in all violent offenses are not changing. This is not to say that the trends are moving horizontally across the time series with no change in rate per 10,000 persons, but rather that the annual variation in one trend is being mirrored by the behavior of the other. Females are not becoming violent at a faster (or slower) relative rate than males over the thirty-six year series.

The ability to make statements such as these has, in the past, been suspect. Different comparisons over time have resulted in disparate findings but the introduction of the econometric techniques outlined in chapter two have provided a new possibility for the testing, and monitoring of relative crime trends. The use of contentiously operationalized variables and various manifestations of regression and other comparative techniques on male and female crime separately has provided little in the way of certainty regarding the presence or absence of convergence. This undertaking has managed to incorporate theoretical direction from the earlier literature while simultaneously eliminating many of the methodological concerns which plagued earlier studies (Box and Hale, 1983). Time series data possess characteristics unusually complex and difficult to isolate and identify. With the additional concern in criminological research of comparing offense trends by sex, many other systematic problems arise regarding crime definitions and formal recording discretion which can only be speculated upon and not adequately controlled. Cointegration analysis provides a method of reducing the question of convergence or divergence down to an empirically testable simple question -- *Is convergence or divergence occurring or is there equilibrium?* These findings confirm the results of many earlier studies which found the lack of convergence

for violent crime and the limited convergence for some property crimes. Moreover, this research is able to clearly dispel the findings of Adler (1975) and Austin (1982, 1993) suggesting convergence for violent offenses using this recently developed method of testing.

With these statements running in the face of much, but not all of the earlier research on convergence, some post hoc reflections should be given regarding the original debate. The theories which were used to explain what was thought to be gender convergence were not unrealistic. The stories that they told were not mere fabrications by feminists (marginalization), anti-feminists (liberation) or pragmatists (routine activities/opportunity) to explain ideologically what was perceived as a growing female crime problem. In their own way, each explanation made sense. That unfortunately resulted in biased interpretations of the findings, unclear conclusions and unbending agenda protection among some key researchers in the field.

In fairness, the earlier work had hurdles to overcome which only time and experience removed. The use of poor statistical techniques was likely not an attempt to mislead but rather indicative of the availability of time series procedures at the time. Incorrect specification of the dependent variables also plagued earlier attempts but again were not intentional. Most importantly, the findings were weak individually because of their collective variability. The massive amounts of research succeeded in providing results with thematic similarities but the data, research designs and findings were usually different enough to bring doubt on the conclusions because consensus remained elusive. As stated earlier, what was confirmed using our new tests (cointegration) is not shaking the foundations of the convergence debate. Despite the exciting conclusiveness, the main contribution can be seen as quiet confirmation of what others have concluded through less reliable means – some convergence may exist for certain property crimes but not for violence offenses.

Earlier, the crimes which failed to be cointegrated were identified and were explained mostly in non-convergence terms. The case of fraud, where convergence could not be discounted gives credibility to the initial concerns about rising female crime but focuses the concern in a much more specific way than Adler (1975) proposed. Furthermore, some of the variations in

cointegration test results which were highlighted across age groups could have diverted attention away from the main assertions of general processes on which this thesis rests.

It would be misleading to posit that there have been no variations in female criminal behaviour which were brought about by the massive social restructuring which has been ongoing since 1962. It would also be misleading to suggest that the changes have been dramatic. Undoubtedly, year-to-year variability rests on the influences of demographic makeup and to a smaller extent economic factors in addition to many other factors such as increased female involvement in the labour force, social welfare programs availing fraudulent incentives to women or the availability of credit which coincide with such increases in fraud. We do not purport to explain everything about the trends in crime rates over the series, but we can say with statistical and visual certainty that male and female crime, including those which failed to meet the strict requirements of cointegration, demonstrate much more in the way of similarity than difference as indicated by their isomorphic signatures.

Unemployment has proven itself to be an interesting addition to the analysis. Because unemployment is intuitively dependent on the number of persons seeking work at a given point in time, it was originally assumed that the effect of unemployment as a predictor would fail in the presence of demographic variables. We now know that for property-related offenses (theft under and robbery), unemployment remains influential even when the effects of demography are controlled. In tables 3.13 and 3.14 it is understood that the demographic effects on crime are captured by the error correction terms and the independent effect of unemployment still remains statistically significant. Consistent with Cantor and Land (1985), unemployment demonstrates both positive contemporaneous and inverse lagged effects on property crime. The interpretation of such findings is speculative but functionalist arguments could be made for the fact that some anomic disturbance (unemployment) is initially responsible for a rise in crime in the same year, followed by a decline after one or two years. Perhaps government support in the form of unemployment insurance or other social welfare provisions may offset the adverse effects of unemployment once they have time to be delivered to the unemployed person as

suggested by Devine, Sheley and Smith (1988). Also, there is a possibility that the equal yet opposite effect of unemployment in its "level" and "lagged" form could be a mere statistical artifact of the way that multiple regression selects the best linear unbiased estimate (BLUE) among variables. Of course, these interpretations are open to criticism because of the aggregate data used in this analysis and the inability to confirm or discount the presence of the ecological fallacy.

Violent crime appears to be motivated by factors other than unemployment. Indeed, for assault, there is no indication that unemployment has any effect on the number of arrests in a given year. This, contrary to the findings of O'Brien (1989), would suggest that violence, like property offenses are the result of demography but not economic strain as measured here. When reconsidering the findings in tables 3.6 – 3.9 in this chapter, there is some evidence for what Broidy and Agnew (1997) refer to as gender-specific responses to strain. All age groups and both sexes demonstrate cointegration between unemployment and theft under, contrary to the suggestion by Naffine and Gale (1989) which stated only males are affected by unemployment. This property crime response may be interpreted as a short term remedy following unemployment. *Adult females and juveniles* of both sexes show cointegrated relationships between unemployment and many of the other possible property crimes tested, especially break and enter for juveniles and fraud for adult women. *Adult male* unemployment is highly cointegrated with robbery (and weakly with fraud) instead of the purely acquisitive and non-violent property crimes. What this suggests is that the contention of Broidy and Agnew (1997) regarding sex distinct responses to strain may find support through this evidence. Specifically, the ideas that (a) males have different *emotional responses* to strain and (b) that males are more likely than females to respond to strain with crime, can aid in the interpretation of these results. If males (especially adults who generally possess greater physical strength) respond to unemployment in more violent and emotional (read aggressive) ways than females, the higher rates of robbery are not unexpected. If adult females and young males and females, who perhaps are not as physically intimidating and do not possess the same brute force and aggression become unemployed and

economically strained, their logical remedy would be property crime as well, but of a non-violent nature.

Demography, as we have repeatedly mentioned is key in understanding the change in crime levels (both property and violent) and the approach taken here has placed great emphasis on the value of the population age structure in predicting crime trends. A final word on the summed ages seems warranted to assure the reader that the created cohort of males 22 & 29 is not laying the blame for all property crime on males of these ages. As was mentioned earlier, there were a number of age combinations (one older age and one younger), which demonstrated cointegrated relationships with property crimes. These ages were added together based on visual inspection and were tested for cointegration with the intention of reserving the best age combination for the final analysis. Purists would suggest that this method of fitting the independent variables to the dependent variable is atheoretical and poor sociological research practice. Rather it is suggested to be far worse were one to blindly accept the orthodox explanation of the age crime relationship if the actual data (figures 2.15 and 2.16) indicate that the relationship is in fact very different. Leamer (1990: 37-38), on the topic of subjective data analysis in economics notes:

> The false idol of objectivity has done great damage to economic science. Theoretical econometricians have interpreted scientific objectivity to mean that an economist must identify exactly the variables in the model, the functional form, and the distribution of the errors. Given these assumptions, and given a data set, the econometric method produces an objective inference from a data set, unencumbered by the subjective opinions of the researcher...[and furthermore]... a fact is merely an opinion held by all, or at least held by a set of people you regard to be a close approximation to all.

This research has taken a similar position regarding the contribution of age structure in explaining crime. Because of this early disagreement (substantiated by evidence from 1996 and 1997) with the generally accepted view of age and crime relationships, the use of some *model building* strategies were warranted instead of rote *model testing*. In effect, the *generally agreed upon fact* of predictably simple age-crime relationships is called into question and the facts, as they existed, were not accepted.

Tables 3.10 and 3.11 provide conclusive evidence of the need to include both young and older persons in the age-crime explanation. The two years added together suggest that many persons in their early twenties commit property offenses only to re-offend in their later years. In this case the early and late ages chosen were 22 and 29 years for males. Males at age 29 who have not declined in their criminal behavior through maturational reform (Gottfredson and Hirschi, 1990) or other life-changing events (Sampson and Laub, 1993) re-offend and elevate the second modality in a property crime trend. Meanwhile there is another wave of males aged in the early twenties who push up the first modality on the property crime trend. It is possible, but remotely so, that there are some persons who become involved in the same crime (theft under) at early ages and then desist while others only become involved in their later years.

Whether ages 21 and 28, or 23 and 30 are used is not really important because the fact remains that these ages are merely proxies for the continued criminality into older age which is obscured by the use of many contiguous ages added together. We are using specific ages as a matter of necessity for the cointegration test and error correction models used (recall that we required integration of the same order for the variables) but the comment being made about the age-crime relationship is much more powerful *and consistent with the evidence provided by the CCJS* (figure 2.15). For Violent crimes, single ages were preferred primarily because they could be used in cointegration tests (older individual ages were integrated of order 1) and the commission of violence appears to be more stable (two widely separated modes) over larger portions of the life cycle than property crimes (figure 2.16).

Briefly, the relationships tested in the error correction models indicate that independent effects on property crime exist for both unemployment and demography. Figure 3.8 presents the very simple path drawing of the effects of the predictors on the dependent variable property crime. The suggestion that these two predictors are completely independent is fallacious as demonstrated by the regression of the male unemployment rate on males 22 & 29. The simple vector autoregression (VAR) equation presented below suggests that demography does indeed have both direct and indirect effects on property crime

through unemployment. In the presence of a lag of the dependent variable on the right hand side of the equation, there remains a significant independent effect of male population age structure on the male unemployment rate.

Male Unemployment **=intercept + b_{yx} (Males Aged 22 & 29) + b_{yx} (lagged Male Unemploy.) + e**

= -0.646 + 0.000008 (Males 22 & 29) + 0.680*** (Lagged Unemploy) + *e***

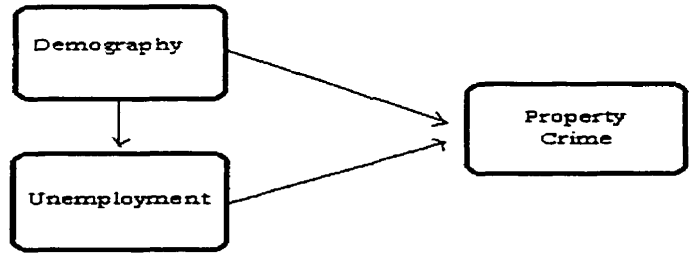
Durbin-Watson *d* = 1.38 (marginally acceptable)
R^2 = 0.804

p<.01 p<.001*****

Still the error correction model III (table 3.13) verifies an independent, significant and strong (multiplying the R^2 threefold) effect of unemployment in addition to the demographic predictive power.

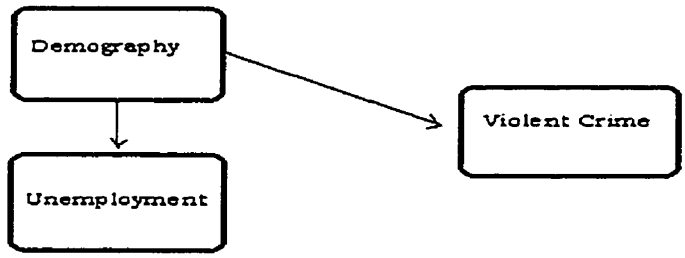
Conversely, table 3.15 indicates that unemployment is not predictive of purely violent crime (assault) but the relationship between demography and offense quantity remains quite strong (p<.05) in addition to the level of violent crime in the preceding year. Figure 3.9 graphically portrays the relationship, as uncovered, between unemployment, demography and violent crime.

Figure 3.8: Illustration of Demography-Unemployment-Property Crime Relationship



These findings are confirmatory, at least to an extent, of the research of Easterlin and the hypothesized relationship between demography, strain and crime. Still, unlike Easterlin's (1978, 1979, 1980) predictions, property crimes are not only affected by the indirect and direct effects of demography but rather exhibit a direct effect of unemployment as well. Also, Easterlin suspected that

Figure 3.9: Illustration of Demography-Unemployment-Violent Crime Relationship



all crime would be a function of the competition for scarce resources brought about by large birth cohorts (the rate of unemployment) but this only seems to apply to acquisitive crimes. Still the competition strain referred to by Easterlin as it applies to violent offenses may be manifested in ways other than economic. Perhaps crowding or increased population density in everyday life may work well in explaining what unemployment cannot. For example, as vehicular volume and crowding on roadways has increased, so too has the prevalence of "road rage" or violent driving tendencies directed at other motorists. Perhaps this phenomenon is not merely limited to drivers.

Finally, there are many new questions introduced by this research despite the answers which it provides. One could chose to explore further the non-cointegrated crime trends by sex and age or the relationship between age, strain and criminal activity by sex. Also, many other short term explanatory variables could be introduced into an error correction model. This analytic form could also be used to address some of the other criminal code offenses not included here, like narcotics and traffic offenses. For our purposes though, this approach of including explanatory models for the largest specific assaultive and property crimes seems worthwhile and sufficiently broad. We are able to concede that certain offenses are not cointegrated (and explain most of these without accepting convergence per se), while definitively determining that most gender-specific crimes are in fact not colliding or diverging, but rather are in relative stasis.

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Appendix A. Annotated Bibliography of Related Research

Author – Period – Sample	Findings and Conclusions
Austin (1982) United States UCR Arrest Data Burglary and Robbery a) All F. (1959-1978) b) F. Youth/Adult (1963-1978) Larceny-theft, embezzlement/fraud, counterfeiting , auto theft (1960-1975)	Primarily a visual inspection of trend lines. Support for convergence in both M. oriented crimes (robbery, burglary, auto theft) as well as fraud and larceny-theft. Suggests clear liberation effect on former but less support temporally for latter offenses. Use of emancipation ratios and FPA
Austin (1993) United States UCR Arrest Data M. and F. Youth and Adult a) Total Index offense b) Individual index crimes excluding rape. Data divided into two periods (1965-1975) & (1975-1986)	Supports the use of M. to F. arrest ratios as comparative tool. Finds greater convergence for younger persons compared to older and also for the earlier period (anomic disturbance) over the later (adjustment). Suggests evidence of convergence for the more serious crimes and not for larceny but contradicts findings in discussion.
Box and Hale (1983) Conviction Data England and Wales (1951-1979) Asserts the points that earlier research failed to look at changing population, M. crime rates and disaggregated crimes. Charges that convergence theorists often measure variables incorrectly and do not apply the appropriate statistical tests. Claims causal relationships are merely concurrent and misleading. Uses differenced models and AR(1) procedure to control for serial correlation.	Concludes that there is little support for the idea of women's liberation causing crime. No significant relationship between liberation and property or violent crimes but composition of the police force was significant for both types of crimes. M. crime trends are determined to be the best predictor of F. crime regardless of the category of the crime. Marginalization of women is viewed as a superior explanation of crime changes for women. This is operationalized by the increase in women (registered as) unemployed and changes in formal state social control placing more emphasis on women.
Box and Hale (1984) Conviction data England & Wales (1951-1980) Prediction of person and property offenses based on F. marginalization and unemployment rate. Uses differenced models and AR(1) procedure to control for serial correlation. Challenges the false use of traditional measures and operationalizations of variables like marginalization and liberation as being too simplistic and misleading	Suggests that there is little support for liberation or emancipation explanations regarding F. crime changes. Claims that the continued, even increased, marginalization of women has resulted in increases in particular offenses like shoplifting and theft from employers are often obscured by the use of large "property crime" categories. Suggests the use of theoretically relevant crimes. Regards the utility of time series analysis for such questions to be lacking and perhaps ineffectual.

Cantor and Land (1985) US UCR data 1946-1982 Examine index crimes individually. Hypothesize contemporaneous negative and lagged positive effect of unemployment rate on crime rates. Proponent of negative opportunity thesis stating that high unemployment is Criminal motivation is entered into an equation with criminal opportunity	Employ differencing techniques to remove secular time trends from data. Findings included significant negative effects of unemployment on all types of crimes and only positive effects on the property offenses. Justification for the lack of support in violent crimes is justified by the often personal nature of these crimes. The U-C relationship can be shown to be positive, negative or null depending on the theoretical and statistical model.
Cohen and Felson (1979) US UCR Data 1947-1974 Question the rise in crime rates despite the improvement of social conditions thought to drive crime. Study trends in robbery, burglary, larceny, rape, assault and murder. Crime rates / billion person hours in a location introduces routine activities. Employs OLS, First Difference Models, and Autoregressive Forms.	Found statistically significant relationship between household activity ratio and all rates of crime using all estimation methods. Proportion of population 15-24 significant for aggravated assault only. Researchers very cautious regarding autocorrelation of errors. Suggests that routine activities and the changing patterns of behavior coinciding "prosperity" contribute to increases in criminal victimization. Suggests that the use of time series data often produces effects in the opposite direction.
Cohen and Land (1987) US UCR and Economic data 1946-1984 Assesses the striking similarity between baby boom cohorts in crime prone years and the patterns in crime trends. Argues models with symmetry of cause should explain both highs and lows in crime trends to be convincing.	Posits the lagged positive and immediate negative effect of unemployment rates on crime, specifically property crimes. State that the age structure-crime relationship appears to be symmetrical with most of the variance in crime trends over the series being explained by age structure, criminal opportunity, economic cycles and imprisonment rates.
Devine, Sheley and Smith (1988) US Data 1948-1985 M. commissions of Homicide, Robbery and Burglary. Suggestion that economic distress (inflation and unemployment) plus the amount of government support (relief spending) affect crime rates. Regression models with AR(1) specifications are used to control for serial correlation .	Population age structure is noted as important in the consideration of crime causation. M.s 16-29 show significant correlation with all crimes, inflation and opportunity. Hypotheses supported but are better explanations of non-violent crimes. The use of first differenced and logged dependent variables address concerns regarding serial correlation but make substantive interpretation difficult. The age grouping (16-29) is too large and results in apparent, but hardly surprising relationship.
Fox and Hartnagel (1979) Conviction Rates- M. and F., Canada 1931-1968. Variables include total fertility rate (TFR), labor force participation (LFP), post-secondary degree rate (PSDR) as measures of F. liberation. Regression analysis and correlation/ratio analysis across genders. Hypothesized a direct relationship between LFP and crime and PSDR and crime and an inverse relationship between TFR and crime.	Interested in the suggestion that F. crime is increasing at a faster rate than M. crime. Most F. increases were found to be in the area of larceny. Suggestion that F. emancipation coincided with increases in F. crime and tested using measures of liberation and traditionalism. Indicates the partial success of the research at confirming the liberation hypothesis but indicates strain and opportunity may serve to explain much of what remains. Recognizes the inherent changes over time in official data.

Hagan (1989) Uses American and Canadian homicide rates/100,000 to address the differences between the countries and demonstrate methodological flaws used in the crime literature. Claims that crime rates have a lot to do with age and racial composition of a country. The history of a group's treatment can account for some criminal behavior.	Notes the misleading and incorrect use of ratio comparisons between national homicide rates in US and Canada. (Deems them inappropriate due to their inconsistent sensitivity to small or large changes in absolute numbers). Disputes "convergence" theory as relating to the two countries rates for most crimes. Spotlights the rise of Canadian burglary to levels exceeding the US.
Hartnagel (1979) Canadian Conviction Data 1931-1968 Time Series M. and F. Total indictable offense, theft, total conviction rate OLS and GLS Regression F. labour participation, education, urbanity, GNP, and fertility rates (IV's)	Findings support liberation hypothesis for theft but fail to support for total crime and indictable offense rates. Acknowledges different motivators towards types of crime suggesting strain, routine activities or opportunity as potential alternatives. Indicates Canadian similarity to U.S. trends.
Hartnagel (1982) INTERPOL Data – 40 countries 1971 Cross-sectional F. Proportion of arrest in four categories: Homicide, larceny, theft and fraud Similar predictors as Hartnagel (1979) Correlational and regression analyses	Some success in explaining fraud and theft. Homicide and larceny unsupported. Discovers unexpected inverse association of urbanity with larceny. Concedes apparent failure of women's role participation as explanatory. Marginalization indicated as alternative.
Hartnagel and Mizannudin (1986) INTERPOL Data – 40 countries 1973-1976 averages as measures Similar predictors as Hartnagel (1982) Two analyses: a) F. proportion of arrest, and b) Rate of crime /10,000 women OLS regression utilized.	Low explained variance in homicide or theft. Only GNP explanatory for larceny. GNP, Urbanity and fertility significant for fraud. Recognition of problems with cross-national data. Strong statements regarding the worth of the theoretical model.
Hartnagel and Gibbs Van Brunschot (1994) UCR Data – Canada, 1962-1992 F.s Only Property, Violence Indices in addition to theft and fraud specifically. Utilizing Time Series Regression analysis. Test of the net effects of changing F. roles, F. economic marginality, social disorganization and state social control on F. crime.	Some promising results for property crimes but not for violence. Gender convergence may be limited to property crime generally and specifically. M.s were not addressed for comparison resulting in modest assertions regarding convergence. Property crimes for women may represent instrumental means of reducing economic deprivation. Unusual positive effect of welfare spending on crime.
Hartnagel (1998) Longitudinal Panel Data – 3 Canadian Cities Four Year tracking of respondents in an attempt to glean life-course understanding of criminal behavior over time. Social control and strain theories used to develop hypotheses.	Unemployment during adolescent-adulthood transition can contribute to criminal behavior. Strain and delinquent peers are found to be highly related to crime. Life-course perspective given support. Social position of youth contributes to criminality among those youth with negative attitudes regarding future employment.

Hirschi and Gottfredson (1983) Argument is made for the invariance of the age-crime curve across crime types, across borders, across the sexes, and through history.	The analysis of various age-crime graphs repeatedly show that there are differences in magnitudes of the trends but the signature of the relationship remains constant. There is a peak in the early twenties or late teens followed by a gradual, or sharp decline. Some variations exist but the basic characteristics hold for all crimes.
Hill and Harris (1991) UCR 1953-1977 Examines rate parity and pattern parity among M. and F. crime trends. Mean slopes are calculated by age and sex for comparison. All index crimes and categories are compared by participation of the sexes.	Objectivist view of opportunity structure changes are contrasted with subjectivist attitudinal changes in F. crime. Predicts that F. employment and liberation will result in decreases in F. frustration (reducing violence) and increasing opportunity (increasing property crime). Discovers overall pattern parity over the series by comparing M. and F. changes over time. Property crimes show greater parity than violent crimes. Youth parity is greater (stronger) than that of adults.
Leiber, Farnworth, Jamieson, Nalla (1994) Seattle Youth Study Sample – 1613 adolescents Dummy variable regression analysis. Strain measured by disjunction in response to two items: "I want to make lots of money" "Do you expect to graduate from college?" Contrasts utilitarian delinquency and non-utilitarian delinquency rated as serious or non-serious.	Addresses gender specific responses to strain to explain the changing F. criminal behavior. Delinquency explanations should work equally explain F. crime. Suggests that strain in pro-feminist (liberated) women should be similar to the strain found in M.s. Both should be higher than non-liberated F.s. Findings show strain levels are similar across all groups but M.s generally experience greater strain as measure by the two questions.
Macmillan (1995) Canadian UCR data 1963-1992 for (robbery, break and enter, motor vehicle theft) Tests the hypothesis that declines in the institutional involvement of M.s aged 15-24, should generate larger crime rates as a consequence of diminished social bonds and social capital. Uses AR(2) and differenced models. Arguments are made for both the motivational and opportunity implications of a rise in the unemployment rate for M.s 15-24.	Results showed good support for the social capital/social bonds hypothesis. Age structure of the population receives some support but not as much as expected. (Perhaps due to the types of crimes selected for the analysis as motor vehicle theft and robbery, although frequently committed by younger persons, also tend to be bimodal across ages of offenders.) Suggests the use of longer time periods and greater measures of social bonds to re-test model. Reporting of exceedingly large R-square values without diagnostic statistics is deceptive and may hide serial correlation.
Maxim (1985) Official Delinquency Statistics 1952-1981 Ontario, Canada Crimes by single year of age for both M.s and F.s. Attempts to partition the effects of age, period and cohort separately. Regression analysis without the necessary safeguards against serial correlation producing misleading R^2 values.	Test of Easterlin's Hypothesis (Age-Period-Cohort) Recognition that many social phenomena will fluctuate according to the relative size of the cohort considered. Age structure and size of birth cohorts are found to affect volume of crime. No Durbin-Watson statistics are provided in results. Finds that age accounts for 28% of variation in M. delinquency and 23% of variation for that of F.s.

Menard (1992) National Youth Survey Longitudinal survey of 11-17 year olds in 1976. Investigates the variability in activity for index offenses, general offenses and drug/alcohol offenses as a function of birth order, age and cohort size (crude births). Dummy variable regression techniques utilized.	Revised Easterlin Hypothesis test. Suggests that age-period-cohort tests benefit from the inclusion of strain, control and learning theory measures. Propose that learning theory largely replaces the effects of age in this more sophisticated model. Actual population values rather than manipulated lagged birth values would have been superior. Discussion fails to provide general mechanism toward all delinquency, rather tailors models to (particular outcome (restrictive explanations).
Naffine and Gale (1989) South Australian Data 1966-1986 Examines trend lines for unemployment rate, break and enter, theft, and total crime rates by sex over the twenty year period.	Suggests that the direction of criminological theory has been guided by a predisposition toward explaining M. crime and "making" F. crime fit the same model with modest success. Portrays potential differences in a hypothetical scenario where F. crime served as the baseline.
O'Brien (1989) UCR Arrest Data 1960-1985 (5 year intervals) All index crimes by individual year of age and age categories. Birth lags used to measure cohort effects. Dummy variable OLS regression utilized.	Economic explanation of criminal motivation is central to the model. Some support for Easterlin's hypothesis for most property crime but not for assaultive crimes. Age and period effects are stronger than relative cohort size. No correction for serial correlation resulting in outrageously high R^2 values with little substantive worth.
Pyle and Deadman (1994) Scottish Data 1979-1991 Unemployment and public housing figures by region used to explore effects of strain on regional crime. Suggest that the U-C relationship must be temporally ordered before the results can be validated. Following the results of Reilly and Witt (1992) there is an attempt to introduce cointegration tests to the data by using quarterly data thereby multiplying the number of data points fourfold.	Suggestion that the clear relationship asserted by Reilly and Witt is unable to withstand more stringent tests of cointegration. The addition of three years of data and the fourfold increase results in reduced explanatory power of earlier model in addition to now unacceptable serial correlation statistics being produced. No cointegration is found between unemployment and crime. Conclude that there is no evidence of dynamic unemployment-crime relationship. Unfortunately all crime is used instead of specific crime thus obscuring the possibility of a crime specific relationship with unemployment.
Reilly and Witt (1992) Scottish Data 1979-1988 Unemployment and public housing figures by region used to explore effects of strain on crime. Generalized Least Squares regression utilized. No Durbin-Watson statistics reported in results indicating possible minimal attention given to problems of serial correlation.	Failure to use gender specific unemployment rates and to distinguish crimes by type despite the different patterns which exist across categories. Explains that multiple measures of strain wash out the significance of each -- unemployment rate is selected as sole and superior measure. Findings of the effects of unemployment are weak and admission of other confounding variables is put forward. Still, faith in unemployment measure as predictive remains.

Sagi and Wellford (1968) US UCR 1958-1964 All crime, property total, violence total Offense specific changes are not addressed (only categories are used). Percentage changes over time are analyzed over the short series. Critical of early data due to bias and changes in recording practices.	Age at risk population largely determines the amount of crime. Approximately 30%-50% of crime increases from 1958-1964 are attributed to changing age structure of the population. Suggests that periodicity of the data is a result of the hiring practices of the police (alternate year hiring increases create rises in crime every other year). Contrary to much of the research which followed it, this research deems the use of total crime rates are thought to be superior to specific crime rates.
Schissel (1992) Canadian UCR (homicide, theft and robbery) and economic indicators 1962-1988 Time series autocorrelation analysis testing the contention that greater rates of crime and imprisonment are the result of both coercive and placative forms of social control. Furthermore, these effects will vary according to crime type where in times of fiscal problems, more emphasis will be placed on control of more serious crimes.	Found U-C relationship to be absent for theft but present for both homicide and robbery. Suggests that unemployment creates the conditions necessary for violent crimes refuting the criminal motivation model of property crimes. M. cohort (aged 15-29) proves to be a good predictor of theft and robbery but not homicide. Charges that crime rates are social constructions and should not be accepted at face value.
Simon (1976) United States UCR Arrest Data Time Series 1932-1972 M & F Property, Violent, Serious, All Crime Use percent and proportion of arrests by sex.	Found evidence of F. gains relative to M.s for property crimes. Gains coincided with NOW movement. No evidence of convergence for violent crimes. Supportive of Liberation Hypothesis. No significance tests.
Steffensmeier (1978) US UCR data 1960-1975 Test of convergence theory through the calculation of F. percentage of arrest for various crime types. Comparison of F. rates of offense through time, F. versus M. rates, and specific increases in particular F. offenses as a proportion of the total. Also, isolation of Women's Movement year tested effect of liberation directly.	Findings were indicative of overstatement of the phenomenon of F.-M. crime convergence. Narrowing of the gap for property crime is largely attributable to fraud/embezzlement and larceny. Warns that apparent narrowing across all property crimes is due to different baselines. Women are still relatively non-violent and gains have been made in shoplifting and passing bad cheques. Test of the "liberation year" failed to support liberation hypothesis.
Steffensmeier, Rosenthal & Shehan (1980) US UCR 1940-1947 Test of whether the drop in M. crime during WWII was the result of age-sex shifts in demography (persons at risk of offending). Further, a test of the tenability of "equalization of sex roles" relative to "changes in law enforcement" explanation for change in F. crime.	Calculation of sex differentials based on 1940 as baseline year. Questioning whether the differential criminal activity of F.s during the war years was an artifact of the different age-sex structure. Findings indicated that much of the difference between the years was attributable to: a) the absence of 12-16 million crime prone M.s, b) the increase in arrests for paternalistic crimes like drug/alcohol charges and prostitution and c) the slight impact of liberation vis-a-vis expanded work roles and freedoms for women.

Steffensmeier and Steffensmeier (1980) US UCR data 1965-1977 Comparison of M. and F. rates as well as percentage involvement by sex. Test of gender convergence hypothesis showed little support for the suggestion that the Women's Movement contributed to the increased criminality of women.	Findings were representative of most work in this area whereby women are found to be increasing their involvement in larceny, liquor law violations, and runaway statutes but not for the "masculine" violent offenses. General claims of gender convergence are unsupported but specific claims have some confirmatory results. Use of rates and percentage change is hazardous due to the vastly different absolute differences across the sexes.
Steffensmeier, Streifel and Harer (1987) US UCR Age specific data 1953-1984 Tested and Age-Period-Cohort model. Questioned: 1) whether different youth cohorts have different levels of "intrinsic" risk of criminal involvement "net" of age and period. 2) whether cohort size is a predictor of cohort variability in criminal involvement. Assumption that period effects across groups are reasonably stable.	Statistics on the index crime rate of specific index offenses showed large age and period effects but small cohort effects. Also, cohort size was not a good predictor of the cohort variability that did exist. Overall, the findings were contrary to the cohort hypothesis whereby larger cohorts had smaller crime rates by comparison. Suggestions for the findings range from the concept of social control "saturation" to inherent flaws in the simple cohort size-crime relationship. Use of age "25 and under" as crime prone is too general to be useful and too exclusive thus ignoring criminal activity of older persons.
Steffensmeier, Allan, Harer, Streifel (1989) UCR data for 1940, 1960, 1980 Examining the existence of stable and universal age-crime curves over time. Expectations: 1) Crime peaks in adolescence or early adulthood, then declines. 2) Crime types vary in the peak ages and the rates of decline. 3) Industrialization over the period will show earlier peaks and steeper declines.	Calculates peak, mean and median age of offending for various crimes to show the variation in the patterns by crime type and age group. Found that even among property offenses there are crimes particularly favored by older offenders (fraud and gambling) and many have mean ages in early twenties. Conclude that there is a trend toward earlier peaks but defends the concepts of heterogeneity of age-crime curves by crime type.
Steffensmeier, Allan and Streifel (1989) INTERPOL data 1970-1976 (69 countries) Regression and decomposition techniques to isolate F. proportion of arrests for homicide, major/minor property crimes. Testing the possibility of an effect of gender equality and marginalization based on structural and developmental predictors of F. crime. Differences in F. crime tested as a function of gender equality, marginalization, opportunity and formalization of social control.	Increases in mainly shoplifting and fraud were related to development perhaps due to availability of credit and the expansion of social welfare programs and self service shopping. Higher levels of social control in more developed countries explains much of the difference in F. proportion of arrest due to the formalization of sanctions that coincide. Most of the gender equality/marginalization views are unsupported by the data. Suggests reasons for the failure of gender equalization hypotheses based on alternate theoretical explanations (opportunity or control).

Steffensmeier and Allan (1990) UCR rates/100,000 ; 1960, 1975, 1990 Explores proportion of total arrests by crime and sex. Also, the proportion of total arrests for each sex attributable to particular offenses is calculated. General position is that age and gender serve as the best and most universal predictors of crime despite criminal convergence hypotheses.	Upon evaluation, there remain only the property crimes of fraud, forgery and larceny which show significant increases in F. participation. Suggests that differences in F. values, socialization, and demeanor coupled with a strong tie to traditional beliefs results in the lower crime rates generally and the proliferation of crime in more "feminized" crimes (related to providing for the home). Liberation thesis is discarded as weak.
Steffensmeier and Harer (1991) UCR and NCS[16] data 1980-1988 Suggests that age explains much of the change in crime rates over the period. Asserts the misplaced credit by police and politicians for falling crime rates.	Using age adjusted crime rate changes. Conclusions were that 100% of the change in UCR crime and 60% of the change in NCS crime were captured by shifts in the demographic makeup of the US. Prediction of continuing downward crime rates with leveling off in the late 1990's.
Steffensmeier, Streifel and Shihadeh (1992) US UCR Data 1953-1989 Arrest rates for single year of age 15-49. Conversion of crime absolute values to rates. Including homicide, assault, robbery, burglary and theft. Dummy variable OLS regression.	Easterlin Test exploring three questions: 1) Is cohort size a cause of crime net of the age and period effects? 2) Is cohort size effect greater for property crimes? 3) Is cohort size effect only for young persons? Results indicated that effect of cohort size may persist through the life-course but overall it is a poor predictor of criminal outcome. Age and period explain most of the variation in crime outcomes although R^2 are unrealistically high and serial correlation is unchecked.
Visher (1983) 785 Police Encounters (M. 643, F. 142) 1977 (four US cities) Maximum Likelihood (Probit) Analysis Calculated gender specific probabilities of arrest based on offense type, suspect characteristics, victim characteristics and the environment of the offense. A greater likelihood to arrest F.s for violent, rather than property offenses was predicted based on the literature.	Concluded: 1) Race, age and demeanor of suspect were significant for both sexes. Preferential treatment more apparent for white, older, and apologetic suspects. 2) Younger women received harsher treatment than older women. 3) F.s are treated according to the image that they project rather than the type of offense they have committed contrary to expectations.
Wellford (1973) Various UCR crime rate series' employed Focused on crime rate change over time and suggested that age composition could explain 50% of the volume increase in crime, due to a swell of persons in the crime prone ages.	Due to rising numbers of persons in the age cohorts of the late teens and early twenties and the proportion of them who are urban and black, youth violent crime is rising at a rate much higher than property offenses. Crime is increasing for all ages but faster for youths and select years in the twenties.

[16] National Crime Survey

Won Lee (1984) Canadian conviction data 1949-1968. Examines the different trends for "indictable offenses" category by age and sex over the period. Calculation of M. and F. rates for age cohort analysis of change over time. Direct comparison of M. and F. percentage change over time as well as trend examination.	Concludes that there is reason to believe F. criminal activity is different from M. activity. Portrays the age-cohort differences in crime rate change by sex to show convincingly that younger persons are more often involved in indictable offenses. Suggests that there are compelling reasons for believing that gender <u>and</u> age interaction may be occurring.

Appendix 2: Crime and Unemployment Rates

Year	Female Crime Rates / 10,000					
	Assault	B & E	Fraud	MurdAtt[17]	MVT[18]	Property
1962	0.83	0.38	0.81	0.03	0.19	5.16
1963	0.91	0.45	1.01	0.02	0.15	6.55
1964	0.94	0.48	1.02	0.03	0.21	7.78
1965	1.09	0.51	1.06	0.03	0.20	8.58
1966	1.35	0.61	1.20	0.04	0.21	9.81
1967	1.20	0.62	1.22	0.03	0.22	10.48
1968	1.47	0.69	1.35	0.05	0.26	11.02
1969	1.54	0.83	1.78	0.06	0.27	12.81
1970	1.74	0.98	2.18	0.05	0.30	16.16
1971	1.93	1.08	2.38	0.07	0.38	18.74
1972	2.15	1.12	2.90	0.09	0.41	20.11
1973	2.60	1.48	3.11	0.09	0.50	22.07
1974	2.65	1.60	3.49	0.10	0.57	24.75
1975	2.80	1.86	3.56	0.11	0.69	27.45
1976	3.00	2.12	4.22	0.12	0.67	30.87
1977	3.15	2.10	4.85	0.12	0.78	29.93
1978	3.37	2.36	5.54	0.12	0.79	34.03
1979	3.44	2.10	5.61	0.13	0.75	33.72
1980	3.78	2.96	6.25	0.10	0.93	38.01
1981	3.96	2.79	6.78	0.13	0.80	39.93
1982	4.00	2.57	6.93	0.13	0.70	40.49
1983	4.65	2.69	6.90	0.13	0.70	41.23
1984	4.98	2.33	7.33	0.12	0.63	40.77
1985	5.63	2.32	7.65	0.12	0.64	40.56
1986	6.28	2.31	8.17	0.12	0.71	41.04
1987	6.99	2.29	7.91	0.14	0.73	41.09
1988	7.61	2.24	7.95	0.13	0.83	40.89
1989	8.28	2.14	7.85	0.11	0.85	40.13
1990	9.54	2.34	8.41	0.14	0.84	42.38
1991	10.84	2.47	9.10	0.09	0.97	45.74
1992	11.29	2.54	8.92	0.13	0.96	44.67
1993	12.42	2.23	7.77	0.13	0.92	41.19
1994	12.62	2.15	6.80	0.10	0.91	35.13
1995	11.97	2.20	6.14	0.10	0.86	34.40
1996	11.76	2.18	5.92	0.09	0.87	33.46
1997	12.64	2.12	5.78	0.09	0.96	30.70

[17] "MurdAtt" signifies the new category comprised of the sum of Murder and Attempted Murder.
[18] MVT (Motor Vehicle Theft)

Appendix 2: Crime and Unemployment Rates (Continued)

Year	Female Crime Rates / 10,000					
	Robbery	Theft Under	Theft Over	Violence	Attempt[19]	Murder
1962	0.07	2.88	0.68	1.02	0.00	0.02
1963	0.11	3.90	0.74	1.12	0.00	0.02
1964	0.11	5.03	0.73	1.13	0.01	0.02
1965	0.15	5.57	0.90	1.33	0.01	0.02
1966	0.10	6.48	0.99	1.57	0.01	0.03
1967	0.14	6.93	1.09	1.42	0.01	0.02
1968	0.17	7.24	1.03	1.75	0.02	0.03
1969	0.18	8.18	1.25	1.84	0.02	0.05
1970	0.25	10.50	1.58	2.10	0.02	0.03
1971	0.26	12.37	1.77	2.31	0.03	0.04
1972	0.22	13.02	1.76	2.49	0.03	0.06
1973	0.34	15.48	0.63	3.08	0.04	0.05
1974	0.36	17.24	0.84	3.16	0.04	0.06
1975	0.42	19.27	0.97	3.40	0.05	0.07
1976	0.43	21.49	1.08	3.59	0.05	0.07
1977	0.45	19.77	1.10	3.75	0.06	0.06
1978	0.44	22.54	1.29	3.98	0.06	0.06
1979	0.41	22.23	1.58	4.03	0.07	0.06
1980	0.56	24.26	1.94	4.51	0.06	0.05
1981	0.54	25.45	2.35	4.70	0.06	0.07
1982	0.52	26.12	2.56	4.75	0.07	0.06
1983	0.48	26.71	2.57	5.42	0.06	0.06
1984	0.48	26.09	2.77	5.74	0.07	0.05
1985	0.45	25.24	3.15	6.39	0.06	0.06
1986	0.50	27.21	0.87	7.07	0.06	0.06
1987	0.46	27.73	0.64	7.84	0.07	0.07
1988	0.52	27.36	0.72	7.77	0.08	0.05
1989	0.49	26.74	0.72	9.17	0.07	0.04
1990	0.53	28.04	0.82	10.46	0.08	0.06
1991	0.65	30.08	0.90	11.86	0.05	0.04
1992	0.76	28.71	1.06	12.51	0.08	0.05
1993	0.72	25.57	0.99	13.61	0.07	0.05
1994	0.66	22.13	0.96	13.74	0.06	0.04
1995	0.73	22.52	0.56	13.07	0.05	0.05
1996	0.80	21.96	0.41	12.86	0.05	0.04
1997	0.76	19.70	0.36	13.73	0.05	0.04

[19] Attempted Murder

Appendix 2: Crime and Unemployment Rates (Continued)

Year	Male Crime Rates / 10,000					
	Assault	Attempt	B & E	Fraud	MurdAtt	Murder
1962	15.10	0.10	20.00	10.00	0.25	0.20
1963	16.20	0.10	22.30	9.80	0.31	0.20
1964	17.60	0.10	22.40	9.90	0.29	0.20
1965	18.80	0.10	21.50	8.80	0.27	0.20
1966	20.50	0.10	21.50	9.30	0.30	0.20
1967	21.10	0.10	29.40	9.50	0.34	0.20
1968	22.30	0.10	27.90	10.90	0.38	0.30
1969	23.10	0.20	31.00	12.20	0.42	0.30
1970	24.50	0.20	31.70	13.60	0.49	0.30
1971	24.70	0.20	31.90	13.40	0.55	0.30
1972	25.00	0.30	31.80	13.10	0.61	0.30
1973	26.50	0.30	34.40	13.50	0.69	0.40
1974	27.10	0.30	38.70	13.40	0.72	0.40
1975	26.70	0.40	44.80	15.20	0.79	0.40
1976	27.60	0.40	46.50	16.20	0.85	0.40
1977	28.00	0.40	46.60	16.70	0.86	0.40
1978	28.70	0.50	48.40	17.90	0.90	0.40
1979	29.20	0.40	41.60	17.60	0.85	0.40
1980	30.80	0.50	59.20	19.70	0.86	0.40
1981	31.00	0.60	61.20	21.40	0.94	0.40
1982	30.30	0.60	58.00	22.00	1.00	0.40
1983	36.30	0.50	58.30	21.60	0.92	0.40
1984	39.60	0.60	49.10	22.10	0.93	0.40
1985	42.70	0.50	49.40	22.50	0.91	0.40
1986	47.40	0.50	48.50	23.20	0.86	0.40
1987	52.40	0.50	46.20	22.00	0.91	0.40
1988	55.50	0.50	43.60	22.00	0.82	0.30
1989	59.60	0.40	38.50	20.50	0.80	0.40
1990	65.00	0.40	40.80	21.60	0.78	0.40
1991	71.70	0.60	44.90	22.40	0.95	0.40
1992	71.30	0.50	41.90	20.80	0.93	0.40
1993	72.80	0.50	36.50	18.30	0.80	0.30
1994	71.20	0.50	32.40	16.40	0.75	0.30
1995	66.80	0.50	29.60	15.10	0.83	0.30
1996	63.60	0.40	28.90	14.50	0.73	0.30
1997	64.00	0.40	26.40	13.20	0.65	0.20

Appendix 2: Crime and Unemployment Rates (Continued)

Year	Male Crime Rates / 10,000					
	MVT	Property	Robbery	Theft Under	Theft Over	Violence
1962	9.75	76.90	2.20	23.00	9.95	20.80
1963	10.11	80.90	2.20	24.80	9.25	21.80
1964	11.02	82.40	2.60	25.40	9.06	24.10
1965	10.53	79.60	2.30	25.00	9.30	24.60
1966	10.06	81.70	2.50	26.30	9.86	26.80
1967	11.13	91.90	2.70	26.80	9.85	27.90
1968	12.00	98.60	3.20	30.20	11.29	29.70
1969	12.89	105.80	3.40	30.30	12.38	30.80
1970	12.83	114.70	3.90	34.10	14.56	32.90
1971	12.37	115.20	3.70	34.90	14.41	32.70
1972	13.12	114.00	3.90	35.30	12.39	32.90
1973	13.62	118.80	4.30	42.00	6.97	35.50
1974	15.86	127.40	5.00	43.40	7.51	36.50
1975	16.59	141.30	6.00	47.60	7.84	36.80
1976	15.83	145.80	5.60	49.00	8.32	37.40
1977	15.64	144.20	5.90	46.50	8.68	38.20
1978	15.08	149.50	5.80	48.30	9.34	39.10
1979	13.04	138.80	5.00	45.60	10.21	38.70
1980	15.38	174.90	6.90	54.30	13.88	42.40
1981	14.74	185.50	6.60	59.30	15.86	42.40
1982	12.22	180.80	6.60	60.50	16.05	41.80
1983	11.24	182.30	5.90	62.60	16.49	47.50
1984	10.24	166.40	5.50	57.90	15.50	51.30
1985	10.54	163.70	5.10	53.80	15.81	55.00
1986	11.11	164.50	5.30	64.10	5.37	60.40
1987	10.83	159.40	5.10	63.60	3.42	65.90
1988	11.11	155.80	5.10	61.60	3.81	69.70
1989	11.53	148.40	5.80	60.60	4.07	75.00
1990	11.95	154.70	5.80	62.20	3.91	81.10
1991	12.88	166.10	7.20	65.10	3.94	89.90
1992	11.97	153.60	7.30	58.80	5.28	90.80
1993	11.50	137.30	6.60	49.10	4.90	91.70
1994	10.50	124.00	6.10	46.20	4.57	88.30
1995	9.65	120.00	6.10	49.60	2.52	82.50
1996	10.03	117.60	6.20	49.30	1.77	77.90
1997	9.17	106.30	5.90	44.90	1.45	77.50

Appendix 2: Crime and Unemployment Rates (Continued)

Year	Unemployment Rates (%)				
	Females 15-19	Females 15 and Over	Males Aged 15-19	Males Aged 15 and Over	Total Unemployment
1962	7.90	3.30	14.40	6.90	5.90
1963	7.70	3.30	14.00	6.40	5.50
1964	7.60	3.10	12.30	5.30	4.70
1965	6.90	2.70	10.20	4.40	3.90
1966	6.40	2.60	9.70	4.00	3.60
1967	7.30	3.00	10.90	4.60	4.10
1968	8.30	3.40	12.70	5.50	4.80
1969	8.90	3.60	12.30	5.20	4.70
1970	11.40	4.50	15.00	6.60	5.90
1971	12.40	5.10	16.30	7.00	6.40
1972	11.30	5.30	15.20	6.80	6.30
1973	10.80	5.10	12.90	5.90	5.60
1974	10.10	4.90	12.70	5.70	5.40
1975	13.50	6.40	16.10	7.40	7.10
1976	15.20	8.40	16.30	6.40	7.20
1977	16.70	9.40	18.10	7.30	8.10
1978	17.20	9.60	16.30	7.60	8.40
1979	15.80	8.70	16.30	6.70	7.50
1980	15.30	8.40	17.00	6.90	7.50
1981	15.40	8.30	16.90	7.10	7.60
1982	18.80	10.80	24.50	11.10	11.00
1983	20.00	11.60	24.10	12.20	12.00
1984	18.50	11.30	21.30	11.20	11.30
1985	16.70	10.70	20.60	10.40	10.50
1986	15.10	9.80	18.20	9.40	9.60
1987	13.70	9.30	16.30	8.60	8.90
1988	12.00	8.30	14.20	7.40	7.80
1989	11.40	7.80	14.50	7.30	7.50
1990	12.80	8.10	15.40	8.10	8.10
1991	15.00	9.70	18.40	10.90	10.40
1992	17.80	10.40	21.70	12.10	11.30
1993	17.50	10.60	22.20	11.80	11.20
1994	16.80	9.90	20.90	10.80	10.40
1995	17.00	9.20	19.80	9.80	9.50
1996	18.50	9.40	21.60	9.90	9.70
1997	20.70	9.20	22.80	9.20	9.20