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International Evidence on Understanding the Determinants of Crime

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ABSTRACT

This study was conducted to investigate the relationship between crime and economic variables such as income, unemployment, inflation, interest rate, and also the political violence, both domestic and regional. The main motivation of the study was to have a better understanding of crime, finding and suggesting alternative way of approaching crime. We analyzed 21 countries, with data spanning from 1960 to 2001.We started our study on this objective by adapting the model and framework that was introduced by Viren (2001) based on Becker (1968), Block and Heineke (1975) and we made slight modification by rephrasing it in order to not only capture the long run relationship but also the short run adjustment. We employed panel-error-correction based cointegration (Persyn and Westerlund (2008)) to analyze and estimate the model. A number of important findings were extracted from the analysis in accordance to the objectives of this study. Firstly, it determines the negative long run relationship between income and crime, ,positive long run relationship between inflation and crime, unemployment and crime as well as lending rate and crime. As for the political violence variable, domestic political violence seems to be negatively related; on the contrary regional political violence is positively related. We believe this might be attributed to the spillover effect. All these signs are as anticipated and justified in this study and are concurrent with most of the past literatures.

INTRODUCTION

Crime is an important subject of study, though sensitive in nature but has been emerging as one of the favorite subject of discussion in recent years across the world. It cannot be argued that crime is an utmost important subject of study; the fact that all layers of society and governments are deeply concerned with the rising statistics of criminal activities, and it is made worse by the exposure give by the media, both electronic and print, highlighting it on a daily basis. The variations in crime rates across countries and regions are quite obvious. The possible explanations of these variations could somehow be pointed to many different reasons, ranging from distinct definitions of crimes and also due to different reporting rates (percentage of the total number of crimes actually reported to the police).

It can also be contributed to different cultural aspects and even democracy as explained by Lin (2007), whereby compared to non-democratic governments, democratic government punish major (minor) crime more (less) and hence this crime rate is lower (higher). It can't be argued that the process of estimating the amount of crime actually committed is not an easy task. The figures do not necessarily provide an accurate picture, because they are influenced by variable factors. Examples of these factors are such as the willingness of victims to report crimes. Media's sensationalizing certain type of crime also seriously distorts the public's view. The better option would be to rely on the compilation and publication of detailed statistics of crime by the respective and responsible government departments.

The loss of property, lives and misery due to crime is well researched and documented. In a study on the United States of America, Freeman (1996) investigated and estimated the total cost due to crime. He duly concluded that for the year 1995, the estimated loss due to crime in the United States of America is roughly estimated to be around 2 percent of its Gross Domestic Product (GDP). He further claimed that another 2 percent of its Gross Domestic Product (GDP) is allotted to fund the crime control activities. In another notable study, this time by Freeman (1996), he claimed that the state of California spent more on prisons compared to the expenditure on other productive sectors such as expenditure on higher education whereby prisons budget allocation increased from 2 percent in 1980 to 9.9 percent in 1995 compared to the shrinking of spending on higher education (12.6 percent in 1980 to 9.5 percent in 1995).

There has been a marked increment in the crime studies looking at the number of studies being conducted. The results are also fiercely debated. Comparative criminology studies have been surfacing and gaining in popularity in recent years, especially quantitative studies to investigate the impact of the development in the society to the crime trends and types of crime.

The development of several new theories have helped is in having a better understanding of the crime phenomenon, Nevertheless, criminologists have developed several theories of the phenomenon. Biological theories of criminal activity were surfacing rampantly throughout the world, especially in the western part towards the end of 19th and early part of 20th centuries, reigniting the interest in crime. The biological characteristics of crime offenders including facial features and their skulls, as well as their chromosomal composition and body type, was the pillar of this theory, however as time go by the support for these theories has waned. In the later part of the 20th century, a variety of hereditary and biochemical factors was linked to the incidence of crime whereby they claimed that an adoptee has a higher probability of ending as a criminal compared to legitimate child though if their adoptive parent was not criminal but their biological parent is. Some other notable studies have claimed that hormonal and certain neurotransmitter imbalances were somehow correlated with crime. Modern crime theories have however pinpointed the occurrence of crime to the strain to the society that is caused due to several phenomenons.

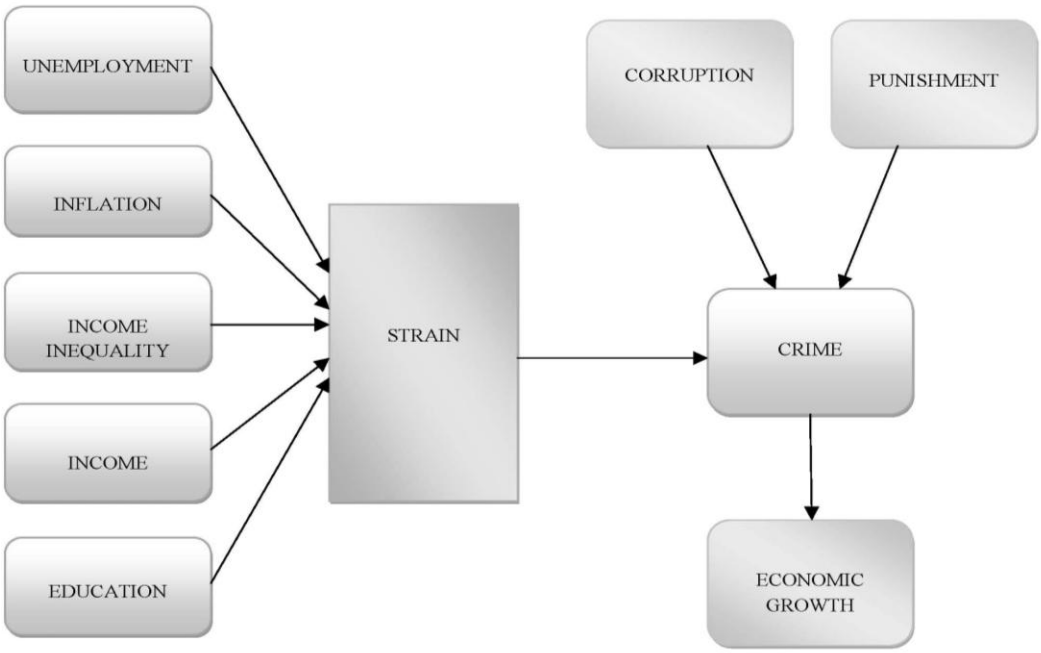
A point to be noted is that the effects of crime encompass mental anguish, misery, the loss of property and lives among others, Imrohoroglu et al. (2006) mentioned that according to United Nations Interregional Crime and Justice and Justice Research Institute, people victimized by property crime (as a percentage of the total population) varied between 14.8 percent in New Zealand to 12.7 percent in Italy, 12.2 percent in U.K., 10.0 percent in U.S., and 3.4 percent in Japan. We agree that comparing crime statistics from different jurisdictions is quite complicated and most of the time it depends on the respective countries legal definitions and will most probably differ across countries, that's why the countries will be chosen meticulously and great attention will be paid in ensuring the uniformity of the crime statistics. It is also due to this complexity, this study will be done on total crimes and not disaggregated crimes since the technicalities involved are very complex.

Apart from these definitional issues, the differences in the levels of reporting of criminal incidents among the countries globally also explain the number of countries chosen in our study. It is important to note that crime data comparison among countries that are fundamentally different might distort our analysis and provide wrong conclusions. To quote a few examples, in some countries it would be Taboo for the women to report cases of sexual abuse, molest or rape compared to other developed nations that encourages the women to be bold and come forward without any fear.

The crime statistics which are available and used in this study is handled with caution, and to avoid discrepancies in the data, we tried to minimize the source. One of the possible explanations for the divergence might be that the data were obtained through different sources. Apart from the discrepancies themselves, is the availability of these data sets, since some countries are reluctant to provide them due to the sensitivities of the data. We went extra mile to ensure that our data have long time series properties, this is critical especially in measuring crime trends over time.

It is a general consensus that crime is closely related with economic variables such as income, income inequality, unemployment, inflation and others. These variables cause strain in the society and ultimately push people to commit crime. The punishment meted out by respective countries also plays a part in attracting people to commit crime. As the study of Levitt (2001) pointed out that the national-level time series data is vital and important in answering criminological questions like these research questions, thus the reason for us to look for continuous time series across countries. Figure 1 below is the theoretical framework of our study in which we strongly believe, and as past literatures have suggested, macroeconomic variables are closely related in the occurrence of crime. The indeed causes strain in the society, and as crime causation theories claimed, these induce crime.

FIGURE 1: Interrelation between macroeconomic variables and crime.



A REVIEW ON RELATED LITERATURE

This chapter will focus on the empirical review on the various links between crime, socio and macroeconomic variable. One of the most important economic variable which is usually associated with crime is the equality and equity variable albeit income inequality or wealth spread. It cannot be denied that equality and equity, which are considered as the norms that promote fairness and thought to be closely related to the level of criminal activities, and economists generally are in the agreement that rising inequality makes problems like poverty and crime more attractive. Numerous esteemed researchers have produced studies on these linkages such as Josten (2003), Chisholm and Choe (2005), Madden and Chiu (1998), Brush (2007) and Lo and Jiang (2007), to name a few.

Josten (2003) strengthened this idea by explaining that individuals who are blessed with above average human capital endowment will most probably engage in legal activity *vice versa* those below normal average will engage in the life of in crime. He further elaborated that worsening income distribution, will lead to envy among the people and will result in an increase in the share of the population that engages in criminal activity and thus, reduces the security of individual property rights. On the other hand, Chisholm and Choe (2005) found that there are mixed and ambiguous results in the empirical studies that use various income variables as a proxy to the expected net gains from crime.

Madden and Chiu (1998) claimed that it just seems reasonable and justified to expect that the level of property crime will somehow be influenced in one way or another by the distribution of income or wealth due to the close relationship between these variables. Brush (2007) investigated the impact of income inequality on crime in United States counties by employing the datasets that are derived from the U.S. Census Office's County and City Data Books corresponding for the period of 1994 and 2000. Brush (2007) employs both cross-sectional and first-differenced approaches and the methods provided some important but differing results, whereby the cross-sectional regression showed that after controlling for the other variables there was a significant positive relationship between the Gini coefficient (which was the proxy for the income inequality) and reported crime rates. On the contrary, the results of the first difference estimation method showed that the dynamism of income inequality has a meaningful adverse relationship with the dynamics of crime rate. He further acknowledged these opposing results, and mentioned that this might be due to either the 10-year time-series dynamics are different from long-term equilibrium cross-sectional relationships or that coefficient estimates are biased in both regression specifications. In this study, we take into account of his suggestion to include more economic variables (other than income inequality) in order to get better results and more robust coefficient estimates

Another time series study linking income inequality and crime that arose the interest and worth mentioning is the study by Lo and Jiang (2007) on the subject of, rising inequality and increasing crime in China, They did mention in their study that during the reform period, China was facing problems of rising income inequality coupled with rising crime rate. They further reiterated that China's phenomenon economic boom increased social inequality and these leads to a rise to a huge floating population which is socially disorganized and has no attachment, commitment, or involvement in communities and it was made worse by the lack of external control and strain which ultimately led to a higher crime rates among the so-called floating population.

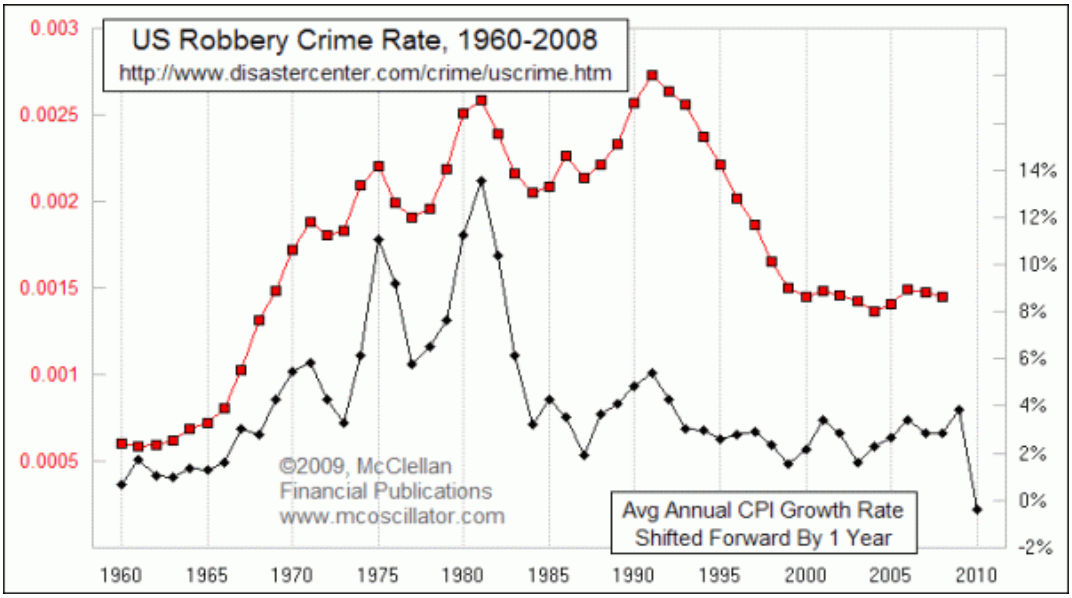
Another prime concern for policy makers and often thought to be closely related with crime is the level of unemployment. Whether the linkage is association or causation still leave many researchers pondering. The results are ambiguous and mixed and often contrary to one another. Notable studies that could not be missed on this subject are as of Agell and Nilsson (2003), and Papps and Winkelmann (1999). Both studies found strong positive relationship between unemployment and crime. In an extensive analysis of aggregate research, One more important study is by Chiricos (1987) who manage to find meaningful and positive linkages between unemployment and crime, especially property crime, in fact he found that unemployment indeed has a statistically significant positive effect on property crime in 40 percent of the studies that he conducted, however the effect of unemployment on violent crime is only found to be statistically significant and positive in 22 percent of the study.

Economic condition also seems to be one of more popular variable in crime studies judging by the large number of literatures using it. It is assumed to be closely related to the level crime. After all it is one of the most important economic variables determining the status of a person or a nation. Recession is believed to be able to cause economic adversity and would encourage criminal activity. As per the elaboration of the iconic Becker (1968), who explained that improvements in legitimate labor market opportunities that are caused by improvement in a nation's economy make crime relatively less attractive. These results clearly support the opinion of economic conditions being related to the economic cycles, such as employment opportunities and salaries in legal activities, have a strong effect on crime.

In contrast, Chisholm and Choe (2005) explained the empirical studies of crime economics with regards to the economic conditions are contradictory to one another and often produce mixed results. Other studies that support improving economic conditions will result in a fall in the level of criminal activity include Pyle and Deadman (1994), Hale (1998) and Masih and Masih (1996).

A general and widely agreed notion of inflation is that, inflation is an event in whereby there is a persistent increase in the level of consumer prices (which is normally reflected by the Consumer Price Index (CPI)) or in other words, a persistent decline in the purchasing power of money, caused by an increase in available currency and credit beyond the proportion of available goods and services. In times of inflation people will find difficulty in finding means to lead a normal life. We believe that these problems will ultimately cause strain and drives people to commit crime, due to be able to lead a life that they used to live before inflation. However, an interesting figure was published on the website of McClellan Financial Publication which is reproduced as Figure 2.1 below, showing astounding relationship between United States robbery crime rate and United States annual CPI growth shifted forward by 1 year. It looks in harmony, the trend is almost identical

FIGURE 2: US Robbery crime rate and US CPI growth +1[1].



Source: McClellan Financial Publication

Studies linking inflation and crime rates are as that of Seals and Nunley (2007) and Coomer (2003). While Seals and Nunley (2007) investigated the effect of inflation and labor market dynamics on property crime rates in United States, Coomer (2003) attempted to explore the relationship between unemployment, inflation and poverty rate and crime also in the United States. Seals and Nunley (2007) were able to conclude that inflation is indeed statistically significant, positive, and persistent for all property crime rates examined. On top of that, they further concluded that price stability contributes considerably to the reduction of property crimes. As for the finding of the later study, Coomer (2003) found that unemployment, inflation and poverty rate were all positively correlated to crime as expected.

As a preliminary conclusion of these literatures, the mixed findings might be due to the omission of important relevant variables such as inflation and unemployment as per their caution, which we intend to rectify in our study. Thus, their empirical results should be accepted with caution as what suggested by the authors, and in order to not repeat the same mistake, in this study we employed a much wider repertoire of variables.

METHODOLOGY

This chapter will focus on the model specification that will be used in this study based on the theoretical arguments in the theoretical and literature review. We will be testing for twenty one countries with data sets spanning from 1961 to 2001. The limited number of countries was due to the need for long time series data for our study. Mainly we will be utilizing panel data analysis, as mentioned by Gujarati (2003), panel data analysis endows regression analysis with both a spatial (cross-sectional units of observation) and temporal (periodic observations characterizing the cross-sectional units over time) dimension. The combination of time series with cross sections can enhance the quality and quantity of data in ways that would be impossible using only one of these two dimensions.

We will employ Pool Mean Group as per Pesaran *et al* (1999) if the panel data is found to be cross-sectional independent, on the contrary if the panel data is found to be cross sectional dependent, we will be employing the Westerlund error-correction-based panel cointegration test (Persyn and Westerlund (2008) which is efficient as as well as computationally more convenient and allows bootstrapping of critical values to overcome cross sectional dependence (if any).

Under this section, the empirical model that will be estimated is discussed.

The general functions are as below:-

[1] http://www.mcoscillator.com/accesed on 19/01/2010

$$CRIME = f\{SOCIO, MACRO, others\}$$
$$GDPc = f\{K, L, H, CRIME\}$$

To evaluate the two general functions above in Equations (1) and (2) the following steps were taken. For the estimation of the determinants of crime as in general model (1), we adapt the model and framework that was introduced by Viren (2001) based on Becker (1968), Ehlrich(1973) , Block and Heineke (1975) and we made some slight addition and modification which we will be elaborating later.

Some details on his work:

- He defines legal activity, *e*, or illegal activity, *h.*
- The return from legal (illegal) activity is *w (r)*. Both rates are assumed to be constant and there are no taxes in the model.
- Utility depends positively on leisure and consumption (and both are assumed normal goods).
- The time allocated to criminal activity may also be comparable to leisure, depending on a valuation partner α. The total leisure time now equals (conventional leisure + α^+ (time spent in criminal activities)). If α =1, time spent in criminal activities equivalent to conventional leisure and if α >1, it is more onerous than conventional leisure, and if α =0, it is equivalent to working time (in legal activity) in which case there would be problems in explaining crime which does not produce any economic reward
- level of criminal activity is *h*
- *s* is severity of punishment, and reduced to common denominator and expressed in money term, thus punishment is expressed as *s.h*
- *p* is the probability someone pursuing crime being caught, and is assumed to be fixed to simplify things.

In line with the existing literature, Viren (2001) modeled decision making as the maximization of expected utility as follows.

$$\underset{\{h,e\}}{Max}\, EU = (1-p)u[1-e-(1-\alpha)h, A+rh+we] + pu[1-e-(1-\alpha)h, A+rh+we-sh] \quad (3)$$

where *u (.,.)* is a strictly quasi-concave utility function which is strictly increasing in its arguments; total leisure *l = (1-e-(1-α)h)* and consumption *c*. Preferences are linear in probabilities.

The first order conditions for the maximization of expected utility are:

$$\frac{\delta EU}{\delta h} = -(1-p)(1-\alpha)\hat{u}_1 + (1-p)r\hat{u}_2 - p(1-\alpha)\tilde{u}_1 + p\tilde{u}_2(r-s) = 0 \quad (4)$$

and

$$\frac{\delta EU}{\delta e} = -(1-p)\hat{u}_1 + (1-p)w\hat{u}_2 - p\tilde{u}_1 + pw\tilde{u}_2 = 0 \quad (5)$$

where

$$\hat{u}_1 = \frac{\delta u[1-e-(1-\alpha)h, A+rh+we}{\delta[1-e-(1-\alpha)h} \quad (6)$$

$$\tilde{u}_1 = \frac{\delta u[1-e-(1-\alpha)h, A+rh+we-sh}{\delta[1-e-(1-\alpha)h} \quad (7)$$

and so on, if p is allowed to depend on h, the first order conditions would include $-p_1\dot{u}+ p_1\dot{u}$ terms, which would, *ceteris paribus*, lower the optimal value of h because increasing time in criminal activity would also increase the probability being caught. Assuming the second order conditions holds, the first order conditions indirectly determine criminal and legal labour supply in terms of exogenous parameters thus can be written as:

$$h = h(\alpha, A, w, r, p, s) \tag{8}$$

and similarly

$$e = e(\alpha, A, w, r, p, s) \tag{9}$$

There is a possibility of a corner solution whereby the most important case is whereby h is zero (no criminal activity). If that were the case, we would end up with the conventional consumption-leisure choice condition $u_1 = wu_2$. It is easy to see that, this case is obtained when $\alpha = 0$ (time spent in criminal activity is just `work' not leisure, and w is high in relation to r but not necessary higher unless s or $p = 0$. On the contrary, e may also be zero with $h > 0$ (individual becomes a full-time criminal). If $\alpha \approx 1$ and $r > w$, this possibility becomes relevant.

Alternatively, one might assume that the legal labor supply, e, is given for an individual either because of social custom (e.g. working-hours agreement) or because of a binding labor supply constraint (unemployment). If e could be assumed to be fixed, say $\bar{e}$, this would simplify the analysis considerably. One could then simply concentrate on the first-order condition for h and, using this as a point of departure, derive the following comparative statistics results with respect to the relevant parameters (assuming all the time an interior solution for h):

$$\begin{gathered} h = h(\alpha, A, w, r, p, s, \bar{e}) \\ + \; - \; - + - \; - \; - \end{gathered} \tag{10}$$

An increase in transfer income tend to decrease criminal activity, an increase in unemployment tends to increase criminal activity. Using a simple separable utility function $u = al + c^b$ where a and b are constant parameters and using an approximation $\dot{u}_2 \approx \dot{u}_2$, which is true when $s=0$, the following closed form solution for h, given $\alpha<1$:

$$h = \left(\frac{1}{r}\right)\left\{-A - w\bar{e} + \left[\frac{b(r - ps)}{\alpha(1-\alpha)}\right]^2\right\} \tag{11}$$

Note that apprehension rate, p and punishment rate, s, have equal effects, as indeed they should have. Assuming that there is indeed a frequency distribution, $f(w)$, over $[a; b]$ in terms of w, one can derive aggregate criminal activity, H, by simply integrating over individuals:

$$H = \int_a^b h(.) f(w) dw \tag{12}$$

Viren (2001) further suggested that variables such as income inequality, demographic variables could be included as explanatory variables to explain the amount of crime in a cross country setting (which we intend to do by including variables such as income inequality, income, inflation, population. corruption, unemployment and others). He further suggested a (log) linear approximation of the supply function such as the one below,

$$H = \beta_0 + \beta_1 p \; + \beta_2 s + \beta_3 e + \beta_4 w + \beta_5 r + \beta_6 A + \varepsilon \tag{13}$$

The above model obviously represents some sort of long run relationship and hence it may not account well for short run or dynamic changes, so in order to accommodate the dynamic change and suits our study the following alteration was done.

Rephrasing Equation (1) as:

$$\ln CRIME_{ijt} = \beta_0 + \beta_1 \ln socio_{it} + \beta_2 \ln macro_{it} + \beta_3 \ln others_{it} + \varepsilon_{ijt} \quad (14)$$

Equation (14) hereby can be extended as follows:

$$\ln CRIME_{ijt} = \beta_0 + \beta_1 GDPpc_{it} + \beta_2 \ln inequa_{it} + \beta_3 \ln \text{int}_{it} + \beta_4 \ln \text{inf} + \beta_5 \ln unemp_{it} + \beta_6 \ln politicalviolence_{it} + \varepsilon_{ijt} \quad (15)$$

Where $CRIME_j$ is the occurrence or incidence of crime per capita.

Thus, due to need to obtain both long run and short run adjustment, and as suggested further by Viren (2001), we came up with an error correction cum cointegration model as per Equation (16) model for crime that will be estimated in our study:

$$\ln totalcrime_t = \alpha_0 + \alpha_1 \ln totalcrime_{t-1} + \alpha_2 GDPpc_t + \alpha_3 \ln inequa_t + \alpha_4 \ln \text{int}_t + \alpha_5 \ln \text{inf}_t + \alpha_6 unemp_t + \alpha_7 \ln politicalviolence_t + \upsilon_t \quad (16)$$

There by specifying $EC_t = \upsilon_t$

$$EC_t = \ln totalcrime_t - (\alpha_0 + \alpha_1 \ln totalcrime_{t-1} + \alpha_2 GDPpc_t + \alpha_3 \ln inequa_t + \alpha_4 \ln \text{int}_t + \alpha_5 \ln \text{inf}_t + \alpha_6 \ln unemp_t + \alpha_7 \ln politicalviolence_t) \quad (17)$$

Subsequently:

$$EC_{t-1} = \ln totalcrime_{t-1} - (\alpha_0 + \alpha_1 \ln totalcrime_{t-2} + \alpha_2 GDPpc_{t-1} + \alpha_3 \ln inequa_{t-1} + \alpha_4 \ln \text{int}_{t-1} + \alpha_6 \ln \text{inf}_{t-1} + \alpha_7 \ln unemp_{t-1} + \alpha_8 \ln wealth_{t-1} + \alpha_9 \ln politicalviolence_{t-1} +) \quad (18)$$

Thus the ECM model to be estimated is as below:

$$\Delta \ln totalcrime_{it} = \beta_0 + \beta_1 \ln EC_{t-1} + \sum_{j=1}^{p} \beta_2 \Delta \ln totalcrime_{i,t-j} + \sum_{j=0}^{q} \beta_3 \Delta \ln GDPpc_{i,t-j} + \sum_{j=0}^{r} \beta_4 \Delta \ln inequa_{i,t-j} + + \sum_{j=0}^{u} \beta_5 \Delta \ln \text{int}_{i,t-jt} + \sum_{j=0}^{v} \beta_6 \Delta \ln \text{inf}_{i,t-j} + \sum_{j=0}^{w} \beta_7 \Delta \ln unemp_{i,t-j} + \sum_{j=0}^{x} \beta_8 \Delta \ln wealth_{i,t-j} + \sum_{j=0}^{y} \beta_9 \Delta \ln politicalviolence_{i,t-j} + \omega_{it} \quad (19)$$

The selected variables for the regressors for the study are as follows:-

- $GDPc_{it}$ is the logarithm of real gross domestic product per capita,
- $inequa_{it}$ is the logarithm of income inequality,
- int_{it} is the measurement for interest rate (lending rate was preferred since its close relationship with crime),
- inf_{it} is the logarithm of inflation,
- $unemp_{it}$ is the logarithm of unemployment,
- $wealth_{it}$ is the logarithm of money supply, used as a proxy for wealth, , and
- $politicalviolence_{it}$ is the logarithm of the political violence incidence both domestic and regional and
- ε_{ijt} is the error term

Problems with Cross Sectional Dependence in Panel Data

As Westerlund (2007) mentioned that recent research has turned toward panel data, in the hope that the estimation and inference can be made more precise through pooling the information contained in a cross-section of similar units, such as countries, regions, companies, or even households due to constrains of short span of many economic time series. He further reiterated that pooling data in this way is valid only if the cross-sectional units are independent of each other, an assumption that is perhaps unreasonable. It is an important task to determine whether the panel data that will be used in this study, are cross section dependent or cross section independent, because only then can we decide to employ the chosen method of pre-testing of order of integration and the decision of estimators to be utilized. If the data are found to be cross section independent, then we will proceed with the first generation panel unit root test such as Maddala and Wu (1999), Levin, Lin and Chu (2002), and Im, Pesaran and Shin (1997, 2003). After the pre-testing we will proceed with the pool mean group estimator as per Pesaran *et al* (1999). On the contrary, if the panel data are found to be cross section dependent, then we will proceed with the second generation panel unit root test such as are Pesaran (2003) and Bai and Ng (2004) whereby both these tests cater for cross sectional dependence. After the pre testing we will proceed to employ the Westerlund error-correction-based panel cointegration test (Persyn and Westerlund (2008)

DATA SOURCE

All variables that will be used in this are obtained from various sources, which are summarized in the following Table .1:-

Table 1 – Definition of variables used in the study

Variable name	**Brief description**	**Sources of data**
Total Crime	Defined as against the 'penal code' or 'criminal code' and excludes less serious crimes (misdemeanors).	Home Office Statistical Bulletin 12/03, Home Office, United Kingdom/ Japan Statistic Department/ New Zealand Law and Justice Department
Income inequality	Data collected based on annual survey of wages in the industrial sector globally.	Deininger & Squire inequality measures and the UTIP-UNIDO pay inequality measures,
Gross Domestic Product per capita	Income per capita	WDI/IFS International Historical statistic
Interest Rate	Lending Rate	WDI/IFS International Historical statistic
Inflation	The change in the Consumer Price Index	WDI/IFS International Historical statistic
Unemployment rate	The rate of unemployment	WDI/IFS
Domestic and Regional Political Violence	The extent to which public power is exercised for private gain, including petty and grand forms of corruption, as well as “capture” of the state by elites and private interests	Integrated Network for Societal Conflict Research (INSCR)

EMPIRICAL RESULTS

To test for cross sectional dependence in this study, Pesarans CD test was preferred over the Breush and Pagan test due to the nature of data in this study which has a finite T and being unbalanced across N. We started the analysis by using crime per capita as the dependant variable while the independent variables are income (gdpc), unemployment (lunemp), inflation (linf), lending rate (lint), income inequality (lineq), major domestic political violence (lregcv) and major regional political violence (lregint). The results are presented in the following Table .1, and from the results, it can be overwhelmingly concluded that it is not cross sectionally independent, we reject the null hypothesis (H_0 : Cross sectionally independent) at 1% level.

Since the results of the cross sectional dependence test shows that the panel data are found to be cross sectionally dependent, we proceed with the second generation panel unit root test, albeit the test proposed by Pesaran (2003) and as written by Pesaran (2003). Iit is parallel to Im, Pesaran and Shin (IPS, 2003) test whereby it is based on the mean of individual DF (or ADF) t-statistics of each unit in the panel. Further, according to Pesaran, to eliminate the cross dependence, the standard DF (or ADF) regressions are augmented with the cross section averages of lagged levels and first-differences of the individual series (CADF statistics). Considered is also a truncated version of the CADF statistics which has finite first and second order moments. It allows to avoid size distortions, especially in the case of models with residual serial correlations and linear trends (Pesaran,2003).

In the case where T is fixed, to ensure that the CADF statistics do not depend on the nuisance parameters the effect of the initial cross-section mean must also be eliminated, this can be achieved by applying the test to the deviations of the variable from initial crosssection mean Pesaran (2003). Lags of the dependent variable may be introduced to control for serial correlation in the errors. The lags of order of the dependent variable in this study were chosen using the Akaikie model selection criteria. An added information from Pesaran (2003) is that in the case of unbalanced panels only standarized Z[t-bar] statistics can be computed, the reason why only standarized Z[t-bar] statistics appear in the results illustrated as per Table 2 and analogous to IPS (2003) test, Pesaran's CADF is consistent under the alternative that only a fraction of the series are stationary.

TABLE 1: Pesaran CD test for Cross sectional dependence

Correlation matrix of residuals:

	c1	c2	c3	c4	c5	c6	c7	c8
r1	1.0000							
r2	-0.0716	1.0000						
r3	-0.0908	-0.1612	1.0000					
r4	0.3565	-0.1185	0.2810	1.0000				
r5	0.7844	-0.2361	0.2574	0.4948	1.0000			
r6	0.4888	0.0530	0.0148	0.7926	0.5137	1.0000		
r7	0.6824	0.2341	-0.0780	0.6062	0.5504	0.6405	1.0000	
r8	-0.4022	0.2231	-0.4148	-0.3407	-0.5052	-0.2503	-0.0204	1.0000
r9	0.8701	-0.2330	0.3402	0.3809	0.8256	0.3991	0.4428	-0.4208
r10	-0.2375	0.2639	-0.5046	0.2506	-0.4898	0.4137	0.2298	0.5178
r11	0.8887	-0.0659	-0.1993	0.5023	0.7911	0.7105	0.5908	-0.5062
r12	0.8343	0.0037	-0.3480	0.6029	0.6791	0.7584	0.8075	-0.4214
r13	0.8436	-0.1122	0.0383	0.7212	0.7993	0.6982	0.6526	-0.4317
r14	-0.5564	0.0999	0.0747	-0.0334	-0.4712	-0.1701	0.1242	0.7015
r15	0.4229	-0.3474	0.4177	0.5279	0.3168	0.4457	0.2534	0.0663
r16	-0.7030	0.0870	-0.1643	-0.3257	-0.7167	-0.1548	-0.4338	0.6937
r17	0.2942	-0.4266	0.5072	0.2359	0.2906	0.2286	-0.1560	-0.1819
r18	0.0220	0.0705	0.0085	0.3096	-0.0673	0.3177	0.1596	0.4931
r19	0.3122	-0.1379	0.4298	-0.1601	0.7882	-0.2601	0.3600	-0.6075
r20	-0.6224	0.0161	0.0757	-0.5083	-0.6324	-0.4787	-0.4263	0.6782
r21	-0.5089	0.0154	0.0335	0.2740	-0.4610	0.1776	-0.2077	0.3462

	c9	c10	c11	c12	c13	c14	c15	c16
r9	1.0000							
r10	-0.6022	1.0000						
r11	0.8361	0.1036	1.0000					
r12	0.6132	0.4809	0.8102	1.0000				
r13	0.7584	0.0934	0.8256	0.7966	1.0000			
r14	-0.4463	0.4133	-0.5511	-0.5252	-0.4173	1.0000		
r15	0.4965	-0.3601	0.4058	0.4317	0.5142	0.0834	1.0000	
r16	-0.5771	0.4450	-0.5681	-0.6016	-0.6989	0.6270	0.1004	1.0000
r17	0.5164	-0.5664	0.3642	0.1996	0.3138	-0.3379	0.6682	0.0476
r18	0.0807	0.2918	0.1895	0.1262	0.1464	0.2150	0.2352	0.4398
r19	0.8665	-0.7624	-0.0273	-0.4411	-0.0290	-0.0761	0.2833	-0.6808
r20	-0.5355	0.2938	-0.7062	-0.7126	-0.7157	0.5922	-0.0474	0.7123
r21	-0.3378	0.3715	-0.1198	-0.0588	-0.1091	0.4381	0.1269	0.7574

	c17	c18	c19	c20	c21
r17	1.0000				
r18	0.2730	1.0000			
r19	0.4754	-0.1434	1.0000		
r20	-0.0447	0.2014	-0.6003	1.0000	
r21	0.1662	0.6934	-0.2797	0.3844	1.0000

Pesaran's test of cross sectional independence = **9.247**, Pr = **0.0000**

From Table .2 it can be safely concluded that at 1% level of significance, the Pesaran CADF test reveal that all series are not stationary at level but are stationary after taking the first difference, in other words they are I(1) variables at 1% level of significance. Therefore it would be essential to proceed with analysis to check for the existence of long run and dynamic relationships among the series.

TABLE 2: Pesaran CADF unitroot test results

Variable	Level	1st difference
Lcrime	-0.550[2]	-5.453[2]***
Lgdpc	1.533 [2]	-3.019[2]***
Linf	-1.574[3]	-5.060[3]***
Lunemp	-1.040[2]	-5.810[2]***
Lint	-1.636[2]	-8.515[2]***
Lineq	-0.577[2]	-6.703[2]***
Lregcv	-1.451[1]	-7.461[1]***
Lregin	0.630[2]	-8.372[2]***

Notes; *** denotes rejection of the null hypothesis at the 1% level, lag(s) in parenthisis[ ]

Preceding the results obtained, and since all series are I(1), we employed the four panel error correction based cointegration test developed by Westerlund (2007). The underlying idea is to test for

the absence of cointegration by determining whether there exists error correction for individual panel members or for the panel as a whole.

According to Westerlund (2007), the tests are very flexible and allow for an almost completely heterogeneous specification of both the long- and short-run parts of the error correction model, where the latter can be determined from the data. It is also a logical choice since it can cater for series with unequal length or in other words, unbalanced panel, and since our data is found to be cross sectionally dependent we obtained the critical values via bootstrapping so that it will be robust as per suggestion by Persyn and Westerlund (2008). Due to the limitation of the analysis and considering degrees of freedom, we analysis two models separately, Model 1 consist income level (lgdpc), inflation (linf), interest rate/lending rate(lint), inequality (lineq), unemployment (lunemp) and internal political violence(lregcv) as the independent variables, while Model 2 consist income level (lgdpc), inflation (linf), interest rate/lending rate (lint), inequality (lineq), unemployment (lunemp) and regional political violence (lregint) as the independent variables.

From the following Table 3, we can conclude that the results are quite robust, though we used different political violence variables in the models, whereby the coefficients are almost identical in both estimations. When the first model was estimated, 14 out of 21 countries namely Austria, Denmark, Finland, Greece, Italy, Netherland, Norway, Poland, Spain, Sweden, Australia, Canada, Japan and the United States of America produced a significant error correction term, while in the second model only 12 out of 21 countries produced significant error correction term (the same countries as previously except for Sweden and the United States of America. Based on the significant error correction term and based on the Granger Representation theorem (Engle and Granger (1987)), which implies that the error correction term will be significant if cointegration exist. Hence we could conclude that cointegration exists between crime incidence and the regress.

Table 3: Results of Error-Correction Model estimation

Country	Model 1	Model 2
1)United Kingdom	-0.125675[-1.00]	-0.1218662[-1.22]
2)Austria	-1.468758[-4.90]***	-1.548432[-5.27]***
3)Cyprus	-0.3466305[-1.18]	-0.3385126[-0.88]
4)Denmark	-0.1315718[-2.70]***	-0.1051445[-2.31]***
5)Estonia	-0.2392652[-1.48]	-0.1407963[-1.50]
6)Finland	-0.003936[-2.33]**	-0.0243719[-1.66]*
7)France	-0.0201682[-0.07]	.-0.0196388[0.10]
8)Greece	-2.053128[-3.84]***	-1.654064[-4.07]***
9)Hungary	-0.674103 [-0.53]	-0.1049742[-0.10]
10)Ireland	-0.0476851[-0.51]	-0.0399215[-0.42
11)Italy	-0.2844191[-2.29]**	-0.2396399[-3.05]***
12)Netherland	-0.0434499[-1.66]*	-0.0717134[-1.99]**
13)Norway	-0.0852008[-2.28]**	-0.0506093[-2.18]**
14)Poland	-0.3106688[-2.40]**	-0.169421[-2.62]***
15)Spain	-0.3987064[-1.69]*	-0.3659124[-1.78]*
16)Sweden	-1.263375[-6.39]***	-0.4446945[-1.19]
17)Australia	-0.7989096[-4.83]***	-0.7989096[-4.83]***
18)Canada	-0.1485437[-2.34]**	-0.1260953[-2.61]**
19)Japan	-0.4433493[-3.92]***	-0.1324564[-2.15]**
20)New Zealand	-0.7034458[-1.32]	-0.7034458[-1.32]
21)United States of America	-0.4414999[-3.90]***	-0.0851018[-0.53]

Notes; */**/*** denotes rejection of the null hypothesis at the 1% level,5% level and 10% level respectively, standarized Z[t-bar] statistics in parenthesis[ ]

Table 4: Estimated long-run relationship and short run adjustment

Variable	Model 1	Model 2
Lgdpc	-1.620376 [-1.68]*	-1.3791343[-1.69]*
Linf	0.2087849[1.35]	0.3527828[0.76]
Lunemp	0.9050554[1.67]*	1.487888[1.69]*
Lint	3.270281[0.83]	0.0259779[0.03]
Lineq	1.568107[1.67]*	1.240228[1.69]*
Lregcv	-1.061771[-1.08]	-
Lregint	-	0.6909483[1.68]*
Error correction term	-.4549504[-3.75]***	-.31786[-2.98]***

Notes; */**/*** denotes rejection of the null hypothesis at the 1% level,5% level and 10% level respectively, standarized Z[t-bar] statistics in parenthesis[ ]

As a group, as per the result displayed in Table 4 above, the panel results are showing a consistent result, whereby the error correction term is significant (this time as a group rather than individual countries as in previous Table 3), implying cointegration, and all the independent variables are showing the same sign of coefficients though they are not identical. Income and domestic political violence have negative relationship with crime incidence while all the other regressors are having positive relationship, while in the second model consistent with the results in the first model; income has negative relationship while all the other regressors including regional violence have positive relationship.

It is interesting to note that, across both the Models, the results are quite consistent and robust, The results show that indeed all the variables chosen as independent variables seems to be cointegrated with crime incidence, although domestic political violence and regional political violence was used interchangeably due to the constraints of the estimator which only allows for 6 covariates, the results seems to be consistent. In the following paragraphs, an elaborative summary on each of the independent variable is given.

Crime and Income

It is a widely accepted belief that income is seen as one of the major macroeconomic variable affecting crime. In this study it is found that income level of the economies seems to have an adverse relationship with crime incidence with an elasticity of ±1, whereby an increase in income level has the tendency of reducing crime. Income is indeed an important determinant of welfare of a human being, thus an increase or decrease in the level of income will definitely increase or decrease the level of strain faced, which will play an important role of push or pull the urge of committing crime as per the psychological theory. The finding is more or less in agreement with most of the literatures Although Chisholm and Choe (2005) claim that studies linking crime and income often produce mixed or contradictory results thus their relationship is ambiguous, it is important to note there are a number of other studies which finds strong cointegration or long run relationship between these variables.

As mentioned by Becker (1968), when a nations economy becomes stronger, improvements in legitimate labour market opportunities make crime relatively less attractive, concluding that improved economic condition (better income level) will reduce crime. Another important study that colludes with our finding is that of Fajnzylber et al (2002) who found that GDP per capita is inversely related with crime. As for the reference for a primary data based study, Levitt (1999) also found a similar result in his empirical study using primary data for the state of Chicago. On a single country analysis frontier, it is worth to mention the study by Habibullah and Law (2007) who also found cointegration between crime and income per capita on their study for Malaysia by using time series data from 1973-2003. Other notable studies which concur with our finding on the adverse relationship between income (GDPc) and crime are studies by Pyle and Deadman (1994), Hale (1998) and Masih and Masih (1996).

Crime and Inflation

Inflation is a phenomenon that is dreaded by almost everyone, no matter which angle we are looking from, the notion, is that it is a persistent increase in level of prices; or persistent decline in the purchasing power, it is safe to conclude that it will burn a hole in the pocket of consumers, which will find it difficult to lead a normal life. It will lead to strain, as mentioned in earlier chapters, and ultimately drives people to commit crime in order to enjoy the same pleasure or same kind of life they are used to. One of earliest literature on this, is the book written by historian David Hackett Fisher(2000) who reiterated the strong correlation between crime and inflation, whereby he traced both the murder and inflation rates in England for over 700 years in his book entitled “The Great Wave”,.

He further elaborated on the patterns of crime incidence, whereby it goes up whenever inflation is high and vice versa. The notable examples of these are the period of the great depression, when crime was low, and the prosperous 80s when crime was record high. Though no econometric or statistical approach was used in his study, nonetheless the explorative by Fisher is an important cornerstone of reference.

In our preliminary result finding, whereby we reproduced the figure by McClellan Financial Publication on the relationship between inflation rate and robbery crime rate in the United States of America, we found out strikingly that it moves in tandem, and true to our expected sign of inflation on crime, we found a positive relationship between crime and inflation throughout our three estimation (total, transition and developed). Previous similar studies linking inflation and crime, and finding that found positive relationship are as those of Seals and Nunley (2007), Coomer (2003), and Tang and Lean (2007).

Crime and Unemployment

It is important to note that majority of the studies (if not all) are in agreeable with our finding, with unemployment being positively related to crime. One of the main effect of being unemployed, is the lost of source of income. It will almost be impossible to cater for the needs of a normal life; it will add enormous strain to the life of consumers, which we believe would push them to the brink of committing crime, thus the unsurprising positive coefficient. It is also concurrent with previous studies which found positive relationship between unemployment and crime such as Agell and Nilsson (2003), and Papps and Winkelmann (1999).

Other agreeable and notable studies on unemployment and crime are as of Chiricos (1987) and Raphael and Winter-Ebmer (2008). Further supporting literatures, the study by Rupert et al (2008), illustrate that the unemployed have the highest propensity to commit crime comparatively with the employed. In another study, this time on the country of France, Fougere et al (2009) also found that crime and unemployment are positively associated, and the increase in youth unemployment induce increases in crime. In studies regarding the United States of America, both studies by Neustrom el al (1988) and Lester (1995) also found similar positive relationship between crime and unemployment.

Crime and Income Inequality

The poor might be tempted to commit crime in order to become rich while the rich commits crime to stay rich. Inequality is a vital indicator of the different classes; a worsening distribution (increasing inequality) will increase the strain vice versa. As priorly expected, we obtained a positive relationship between inequality and crime. This is another aspect of this study which concurs with almost all the studies. Large number of studies seems to share similar findings, such as Josten (2003), Madden and Chiu (1998), Fajnzylber et al (2002a, 2002b), Imrohoroglu et al (2006), Teles (2004) Lorenzo and Sandra (2008), Magnus and Matz (2008), Brush (2007), Lo and Jiang (2007) while an opposing finding was recorded by Choe (2008), who found a negative finding for the sub-component of crime (burglary and robbery). While Teles (2004) claimed that monetary and fiscal policy (which indirectly influence income inequality) have impacts on crime, Madden and Chiu (1998) reiterated that it seems reasonable to expect that the level of property crime will be influenced in some way by the distribution of income.

Crime and Interest rate (lending rate)

It was rare for studies of determinants of crime to include interest rate as one of their independent variables, however we included it because we believe it is closely related to crime, whereby a high interest rate will be burdensome to consumers to repay the loan taken and might entice them to commit crime vice versa a comparatively lower interest rate will give an alternative for them to venture into something legal and meaningful, and for that reason the interest rate that was chosen was the lending rate, and true to our notions and presumptions, we found a positive relationship between the lending rate and the crime.

Crime and political violence

Another important variable that is rarely used in previous studies are the domestic political violence and regional political violence. We believe that these incidences tends to create chaotic situations leading to occurrence f crime, however due to the limitations of the estimator which allows on 6 covariates at any point of time due to the size of the sample, we used them interchangeably. We are

pleased to note the robustness and consistency of the results no matter which variable was used, the sign of the other coefficients remain the same. The results are quite interesting, while the domestic political violence is negatively related to the level of crime; regional political violence is positively related to crime. No comparison could be made with previous literatures since as far as we are concerned have used these variables. The conclusion that we could possibly make is that it might be due to the spillover effect, whereby whenever a domestic political violence occurs people who are affected will be moving out of the country and possibly committing crime in another country which possibly explain the positive relationship between regional political violence and crime.

CONCLUSION

A number of important findings are extracted from the analysis, most importantly, it determines and confirms the negative long run relationship between income and crime, a higher income would enable the people to enjoy a better life, and vice versa worsening income could induce strain and create pressure on people. As for the positive long run relationship between inflation and crime, the logic and explanation is almost the same, whereby while higher prices would enable firm and business to receive much higher return and profit, majority of people, who are actually fix income earners would definitely feel the pinch due to high prices which translate to worsening purchasing power, again which will induce strain;

On the other hand the same relationship for unemployment and crime as well as lending rate and crime. Losing a source of income, means one has to fend elsewhere in order to survive, some might take the shortcut, which is committing crime. A steep lending rate is a nuisance for people since the cost of repayment is burdensome. As for the political violence variable, domestic political violence seems to be negatively related; on the contrary regional political violence is positively related. We believe this might be attributed to the spillover effect. Whenever domestic political violence erupt, people will be fleeing away, thus the logic of the negative sign, at the same time, whenever there are regional political violence, outsiders proliferate the country, and might contribute to the increase in crime (positive relationship). All these signs are as anticipated and justified in this study and are concurrent with most of the past literatures.

This study also shows the importance of policy makers in drafting and executing crime combating policies to think out of the box, rather combating the traditional way of keep increasing and keep meting out severe sentence, they should focus in preventing the crime via correcting the macro imbalance.

REFERENCES

Agell, J. and Nilsson, A (2003) Crime, Unemployment and labor market programs in turbulent times. *forthcoming in the Journal of the European Economic Association*

Bai, J. and Ng, S (2004) A PANIC attack on Unit roots and cointegration, , *Econometrica*, 72(4), 1127-1178

Becker, G.S. (1968) Crime and punishment: An economic approach. *Journal of Political Economy* 76, 1169-1217

Brush, J. (2007). Does income inequality lead to more crime? A comparison of cross-sectional and time-series analyses of United States counties. *Economics Letters* 96: 264–268.

Coomer, N. (2003). America's underclass and crime: The influence of macroeconomic factors. *Issues in Political Economy*, Vol. 12

Chisholm, J. and Choe, C. (2005) Income variables and the measures of gains from crime. *Oxford Economic Papers* 57(1), 112-119

Chiricos, T. (1987) rates of crime and unemployment: An analysis of aggregate research evidence *Journal of Social Problems* 34, 187-211

Ehrlich, I. (1973) Participation in illegitimate activities: A theoretical and empirical investigation. *Journal of Political Economy* 38(3), 521-565

Engle, R. F. and C. W. J. Granger (1987), "Co-integration and error correction: Representation, estimation and testing," *Econometrica*, 55, 251–276

Freeman, R.B. (1996). Why Do So Many Young American Men Commit Crimes and What Might We Do About It. *Journal of Economic Perspectives* 10(1): 25-42.

Gujarati, D.N. (2003) Basic Econometrics, *McGraw-Hill:New York*

Hale, C. (1998). Crime and the Business Cycle in Post-War Britain Revisited. *British Journal of Criminology* 38(4): 61-698.

Imrohoroglu, A., Merlo, A. and Rupert, P. (2006) Understanding the determinants of crime. *Journal of Economics and Finance* 30(2), 270 – 283.

Im, K.S., Pesaran, M.H. and Sin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115, 53-74

Levitt, S.D. (2001) Alternative strategies for identifying the link between unemployment and crime. *Journal of Quantitative Criminalogy* 17(4) 377-390

Lo, T. W. and Jiang, G. (2007). Inequality, crime and the floating population in China. *Asian Criminology* 1: 103-118

Josten, S.D. (2003) Inequality, crime and economic growth. A classical argument for distributional equality, *International Tax and Public Finance* 10, 435-452

Lin, M.J. (2007) Does democracy increase crime? The evidence from international data. *Journal of Comparative Economics* 35, 467-483

Maddala, G.S. and Wu, S. (1999). A comparative study of unit root tests with panel data and new simple test. *Oxford Bulletin of Economics and Statistics*, Special Issus, 631-652

Madden, P. and Chiu, W. H. (1998). Burglary and income inequality. *Journal of Public Economics* 69: 123–141

Masih, A.M.M. and Masih, R. (1996). Temporal Causality and the Dynamics of Different Categories of Crime and Their Socioeconomic Determinants: Evidence from Australia. *Applied Economics* 28: 1093-1104

Pesaran, M.H. (2004), General diagnostic test for cross section dependence in panels. *CESifo Working Paper No 1229, Category 10: Empirical and theoretical methods*

Papps, K.L and Winkelmann (1999) Unemployment and crime: New evidence for an old question. *IZA and Centre for Economic Policy Research* 1-16

Persyn, D. and J. Westerlund. 2008. Error Correction Based Cointegration Tests for Panel Data. Stata Journal 8 (2), 232-24

Pesaran, M.H., Shin Y. and Smith, R.P (1999), Pooled mean group estimation of dynamic heterogeneous panels. *American Statistical Association*, 94(446), 621-634

Pyle, D.J. and Deadman, D.F. (1994). Crime and the Business Cycle in Post-War Britain. *British Journal of Criminology* 34(3): 339-357.

Seals, A. and Nunley, J. (2007). The effects of inflation and demographic change on property crime: A structural time series approach. *Department of Economics and finance working paper series* April 2007.

Viren, M. (2001), Modelling crime and punishment, *Applied Economics*, 33, 1869-1879

Westerlund, J.(2007). Testing for Error Correction in Panel Data. Oxford Bulletin of Economics and Statistics 69(6): 709-748