

# Crime and Its Socio-Macroeconomics Determinants: A Panel-Error-Correction Cointegration Analysis

*(Jenayah dan Penentu Ekonomi Sosio-Makro: Kointegrasi Pembetulan Ralat Panel)*

**Baharom Abdul Hamid**

Taylor's Business School  
Taylor's University

**Muzafar Shah Habibullah**

Faculty of Economics and Management  
Universiti Putra Malaysia

**Zaleha Mohd Noor**

Faculty of Economics and Management  
Universiti Putra Malaysia

## ABSTRACT

*This study investigates the relationship between crime and socio and macro economic variables such as income, unemployment, inflation, interest rate, and also the political violence, both domestic and regional. The main motivation of the study is to have a better understanding of crime as well as finding and suggesting alternative ways of approaching crime. We analyzed 21 countries, with data spanning from 1960 to 2001. We adopted the model and framework introduced by Viren (2001) based on Becker (1968), Block and Heineke (1975). However, we slightly modified by rephrasing it in order not to only capture the long run relationship but also the short run adjustment. We employed the panel-error-correction based cointegration (Persyn and Westerlund (2008)) to analyze and estimate the model. A number of important findings are extracted from the analysis in accordance to the objectives of this study. Firstly, we discover a 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 the signs are as anticipated and justified in this study; and are concurrent with most of the past literatures.*

*Keywords: Crime; economic variables; panel-error correction based cointegration*

## ABSTRAK

*Kajian ini menyelidik perhubungan di antara jenayah dan pembolehubah ekonomi sosio dan makro seperti pendapatan, pengangguran, inflasi, kadar faedah serta jenayah politik, merangkumi domestik dan wilayah. Motivasi utama kajian adalah demi mendapat pemahaman lebih baik mengenai jenayah serta mendapatkan hasil kajian serta mencadangkan cara alternatif memerangi jenayah. Kami menganalisis 21 negara, data mencakupi tahun 1960 hingga 2001. Kami mengadaptasi model serta kerangka yang diperkenalkan oleh Viren (2001) berasaskan Becker (1968), Block dan Heineke (1975). Walau bagaimanapun, kami membuat sedikit pengubahsuaian dengan hasrat bukan sahaja mendapat kesan jangka panjang, tapi juga penyesuaian jangka pendek. Kami menggunakan Kointegrasi Pembetulan Ralat Panel (Persyn and Westerlund (2008)) untuk menganalisa dan meramal model. Sejumlah hasil dapatan dapat ditemui dari analisis ini bersandarkan objektif kajian. Pertama, kami mendapati terdapat hubungan jangka panjang negatif diantara pendapatan dan jenayah; hubungan positif jangka panjang diantara inflasi dan jenayah; pengangguran dan jenayah; serta kadar faedah dan jenayah. Manakala untuk jenayah politik, jenayah politik domestik didapati berhubung negatif; berlawanan dengan kejayaan politik wilayah yang berhubung positif. Kami percaya ini mungkin diakibatkan oleh kesan limpahan. Kesemua dapatan kajian adalah seperti diramal dan dijustifikasikan didalam kajian ini; dan selari dengan kebanyakan kajian lampau.*

*Kata kunci: Jenayah; pembolehubah ekonomi; Kointegrasi Pembetulan Ralat Panel*



## INTRODUCTION

Crime is an important subject of study; though sensitive in nature but it has emerged as one of the favorite subjects 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. Further, this has been made worse by the exposure given by the media, both electronic and print by 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 by different cultural aspects and even democracy as explained by Lin (2007); whereby compared to non-democratic governments, democratic government punishes major (minor) crime more (less) and hence this crime rate is lower (higher). It cannot be argued that the process of estimating the number 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 sensationalizing certain types 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 are 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 was 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) was allotted to fund the crime control activities. Freeman (1996) further claimed that the state of California spent more on prisons compared to the expenditure of 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).

Looking at the number of studies being conducted, there has been a marked increment in the crime studies. 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 has helped to understand the crime phenomenon. Nevertheless, criminologists have developed several theories of the phenomenon. Biological theories of criminal activity are surfacing rampantly throughout the world, especially in the western world towards the end of 19th and early part of 20th centuries; reigniting the interest in crime studies. The biological characteristics of crime offenders including facial features and their skulls, as well as their chromosomal composition and body type, are the pillars of this theory. However, as time goes by, the support for these theories has waned. In the later part of 20th century, a variety of hereditary and biochemical factors have been linked to the incidences of crime whereby they claimed that an adoptee has a higher probability of ending as a criminal compared to a biological child because even if their adoptive parent is not criminal but their biological parent is. Some other notable studies have claimed that hormonal and certain neurotransmitter imbalances are somehow correlated with crime. Modern crime theories have however pinpointed the occurrence of crime to the strain in society that is caused due to several phenomena.

A point to be noted is that the effects of crime encompass mental anguish, misery, the loss of property and lives among others. Imrohorglu et al. (2006) mentioned that according to United Nations Interregional Crime and Justice and Justice Research Institute, people being victimized by property crime (as a percentage of the total population) varies 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 definition and will most probably differ across countries. That is 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 that 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 also explain the number of countries chosen in our study. It is important to note that comparing data on crime 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 encourage the women to be bold and come forward without any fear.

The crime statistics which are available and used in this study are 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 are 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 sensitivity of the data. We took extra effort to ensure that our data have long time series, as 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. The study of Levitt (2001) pointed out that the national-level time series data are vital and important in answering criminological questions as these research questions; thus, a 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. They indeed cause strain in the society, and as crime causation theories claimed, these induce crime.

The after effect of crime is also devastating; its impact on an economy, its development, as well as the amount of money and energy generated to minimize the crime incidences are quite significant. The cost of crime to the economy is quite enormous, thus the need to understand and tackle the complicated issues is found wanting, thus the motivation of this study.

As per the interrelation between the economic variables and crime as in Figure 1, unemployment is one of the most popular variables that are normally thought to be closely related with the occurrence of crime. Losing

a source of income, would induce strain, would act as a catalyst to drive people towards crime, where primarily is to sustain their lives. On the other hand, for those who are used to living in the fast lane, crime would be an attractive choice in sustaining their high standard of living. Moving towards inflation, it cannot be dismissed that any increase in general price level would result in a decrease in purchasing power; thus, creating strain which in turn would propel people to commit crime.

As for income inequality, a wide gap could create tension and strain; jealousy could creep in and could create uneasiness and push the lower bracket of income earners to commit crime. The level of income itself could also act as a catalyst for crime; extremely low level of income would translate into hardship in life, which in turn will create strain. Level of education, could be related to crime from two perspectives. One, the higher the level of education, the more sophisticated the people could become criminals; on the other hand, low level of education could also be the reason on why people committing crime. Thus the need to analyze all the variables is crucial, in order to understand their relationship with crime incidences.

#### A REVIEW ON RELATED LITERATURE

This section will focus on the empirical review on the various links between crime and, socio- macroeconomic variable. Among of the important economic variables that usually being associated with crime are the equality and equity variables. It cannot be denied that equality and equity which are considered as the norms that promote

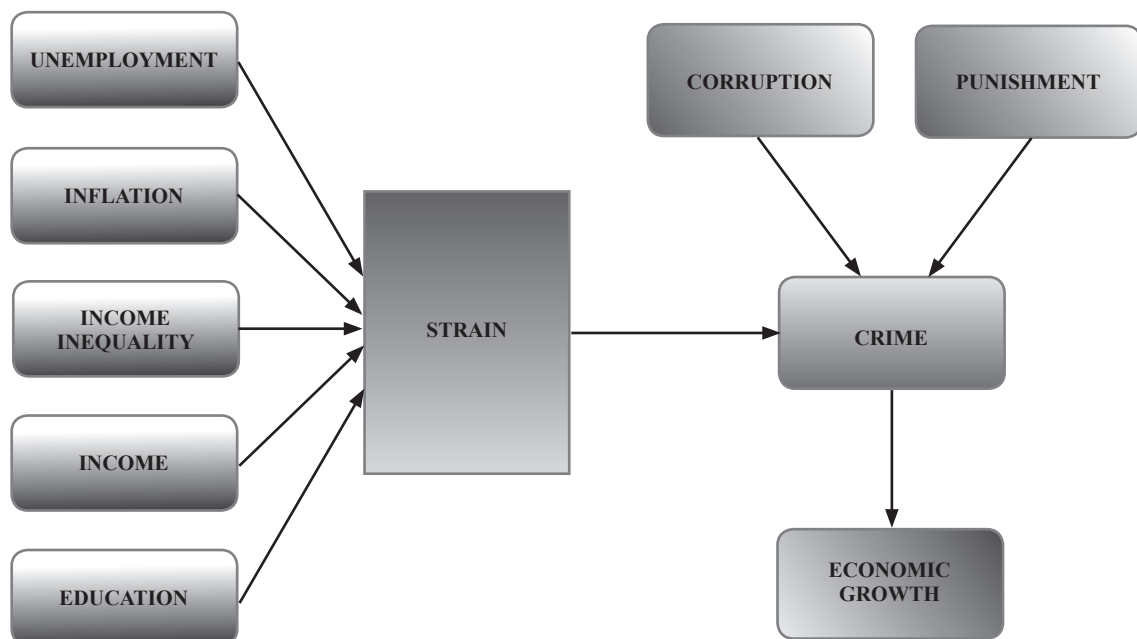


FIGURE 1. Interrelation between Socio and Macroeconomic Variables and Crime

fairness are thought to be closely related to the level of criminal activities. 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; and vice versa where for those of 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. 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 were derived from the U.S. Census Office's County and City Data Books corresponding for the period of 1994 and 2000. He employed both cross-sectional and first-differenced approaches and the methods produced some important but differing results. The cross-sectional regression showed that after controlling for the other variables there is 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 were different from long-term equilibrium cross-sectional relationships or that coefficient estimates were 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. 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 leaves many researchers pondering. The results were ambiguous and mixed and often contradicted to one another. Notable studies that could not be missed on this subject are by 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 managed 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. Other studies linking income inequality and crime are by Baharom and Habibullah (2008), where they duly concluded that income inequality in Malaysia is not related with crime in Malaysia.

Economic condition also seems to be one more popular variable in crime studies judging by the large number of literatures that are using it. It is assumed to be closely related to the level of crime. After all, it is one of the most important economic variables in determining the status of a person or a nation. Recession is believed to be able to cause economic adversity and would encourage criminal activity. Becker (1968) explained that improvements in legitimate labor market opportunities caused by improvement in a nation's economy makes crime relatively less attractive. These results clearly supported the opinion of economic conditions related to the economic cycles; such as employment opportunities and salaries in legal activities, having 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 produced 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), Habibullah and Law (2007) and Habibullah and Baharom (2008).

A general and widely agreed notion of inflation is that, inflation is an event whereby there is a persistent increase in the level of consumer prices (which is normally reflected by the Consumer Price Index (CPI)). In other words, it is 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 encounter difficulty in finding means to lead a normal life. We believe that these problems will ultimately cause strain and drive people to commit crime, as they are unable to lead the life that they were used to prior to inflation. However, an interesting figure published on the website of McClellan Financial Publication, reproduced in Figure



2.1 below, show an astounding relationship between United States robbery crime rate and United States annual CPI growth shifted forward by 1 year. They seem to be in harmony, their trends are almost identical.

Studies linking inflation and crime rates are attributed to Seals and Nunley (2007) and Coomer (2003). Seals and Nunley (2007) investigated the effect of inflation and labor market dynamics on property crime rates in United States and they found that, inflation is indeed statistically significant, positive, and persistent for all property crime rates examined. Coomer (2003) attempted to explore the relationship between unemployment, inflation and poverty rate and crime also in the United States and found that unemployment, inflation and poverty rate are all positively correlated to crime as expected.

METHODOLOGY

This section will focus on the model specification 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 is due to the need for long time series data for our study. Only these 21 countries have consistent and uniformed data available on a long time series basis. 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 estimator as per Pesaran et al. (1999) if the panel data are found to be cross-sectional independent. However, if the panel data are found to be cross sectional dependent, we will be employing the Westerlund error-correction-based panel cointegration test (Persyn and Westerlund (2008). It is efficient 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:-

$$CRIME = f\{SOCIO, MACRO, others\} \tag{1}$$

Equation (1) could be expanded to:

$$\ln CRIME_{ijt} = \alpha_0 + \alpha_1 \ln socio_{it} + \alpha_2 \ln macro_{it} + \alpha_3 \ln others_{it} + \varphi_{ijt} \tag{2}$$

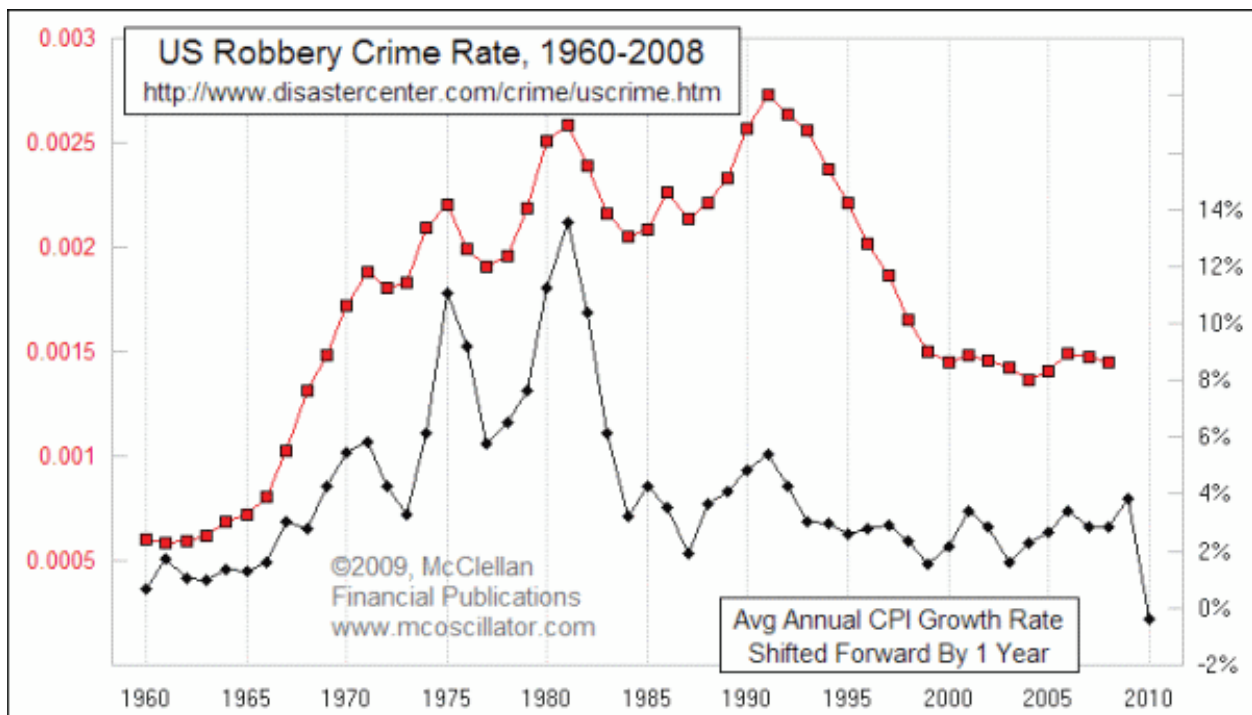


FIGURE 2. US Robbery Crime Rate and US CPI Growth +1

Source: McClellan Financial Publication (<http://www.mcoscillator.com>/accessed on 19/01/2010)

Equation (2) hereby can be extended as follows:

$$\begin{aligned} \ln CRIME_{ijt} = & \beta_0 + \beta_1 \ln GDPpc_{it} + \beta_2 \ln inequa_{it} \\ & + \beta_3 \ln int_{it} + \beta_4 \ln inf_{it} + \beta_5 \ln unemp_{it} \\ & + \beta_6 \ln politicalviolence_{it} + \varepsilon_{ijt} \end{aligned} \quad (3)$$

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

Thus, due to the 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 (4) model for crime that will be estimated in our study:

$$\begin{aligned} \ln totalcrime_t = & \alpha_0 + \alpha_1 \ln totalcrime_{t-1} + \alpha_2 \ln GDPpc_t \\ & + \alpha_3 \ln inequa_t + \alpha_4 \ln int_t \\ & + \alpha_5 \ln inf_t + \alpha_6 \ln unemp_t \\ & + \alpha_7 \ln politicalviolence_t + v_t \end{aligned} \quad (4)$$

Thereby specifying  $EC_t = v_t$

$$\begin{aligned} EC_t = & \ln totalcrime_t - (\alpha_0 + \alpha_1 \ln totalcrime_{t-1} \\ & + \alpha_2 \ln GDPpc_t + \alpha_3 \ln inequa_t + \alpha_4 \ln int_t \\ & + \alpha_5 \ln inf_t + \alpha_6 \ln unemp_t \\ & + \alpha_7 \ln politicalviolence_t) \end{aligned} \quad (5)$$

Subsequently:

$$\begin{aligned} EC_{t-1} = & \ln totalcrime_{t-1} - (\alpha_0 + \alpha_1 \ln totalcrime_{t-2} \\ & + \alpha_2 \ln GDPpc_{t-1} + \alpha_3 \ln inequa_{t-1} \\ & + \alpha_4 \ln int_{t-1} + \alpha_5 \ln inf_{t-1} + \alpha_6 \ln unemp_{t-1} \\ & + \alpha_7 \ln politicalviolence_{t-1}) \end{aligned} \quad (6)$$

Thus the *ECM* model to be estimated is as below:

$$\begin{aligned} \ln totalcrime_{it} = & \beta_0 + \beta_1 \ln EC_{t-1} \\ & + \sum_{j=1}^p \beta_2 \Delta \ln totalcrime_{i,t-j} \\ & + \sum_{j=0}^q \beta_3 \Delta \ln GDPpc_{i,t-j} \\ & + \sum_{j=0}^r \beta_4 \Delta \ln inequa_{i,t-j} \\ & + \sum_{j=0}^u \beta_5 \Delta \ln int_{i,t-j} \\ & + \sum_{j=0}^v \beta_6 \Delta \ln inf_{i,t-j} \\ & + \sum_{j=0}^w \beta_7 \Delta \ln unemp_{i,t-j} \\ & + \sum_{j=0}^y \beta_8 \Delta \ln politicalviolence_{i,t-j} \\ & + \omega_{it} \end{aligned} \quad (7)$$

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

- ▶  $\ln GDPpc_{it}$  is the logarithm of real gross domestic product per capita,
- ▶  $\ln inequa_{it}$  is the logarithm of income inequality,
- ▶  $\ln int_{it}$  is the measurement for interest rate (lending rate was preferred since its close relationship with crime),
- ▶  $\ln inf_{it}$  is the logarithm of inflation,
- ▶  $\ln unemp_{it}$  is the logarithm of unemployment,
- ▶  $politicalviolence_{it}$  is the logarithm of the political violence incidence both domestic and regional and.
- ▶  $\varepsilon_{ijt}$  is the error term.

As mentioned earlier, because of the constraint in getting long time series data that is uniformed, we could only end up with twenty one countries (21) which are United Kingdom, Austria, Cyprus, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Netherland, Norway, Poland, Spain, Sweden, Australia, Canada, Japan, New Zealand and United States of America.

#### PROBLEMS WITH CROSS SECTIONAL DEPENDENCE IN PANEL DATA

Westerlund (2007) mentioned that recent research has turned toward panel data, in the hope that the estimation and inference made can be more precise through the pooling of 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 important to determine whether the panel data that will be used in this study, are cross section dependent or cross section independent. This is 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 sectional independent, then we will proceed with the first generation panel unit root test as done by 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 sectional dependent, then we will proceed with the second generation panel unit root test as done by Pesaran (2003) and Bai and Ng (2004) whereby both of 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).

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). The crime rate, or the number of cases reported are used.	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. It is the real income in US dollars.	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)

DATA SOURCE

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

EMPIRICAL RESULTS

To test for cross sectional dependence in this study, Pesaran’s CD test was preferred over the Breush and Pagan test due to the nature of data in this study which have 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 (gdp), unemployment (lunemp), inflation (linf), lending rate (lint), income inequality (lineq), major domestic political violence (lregcv) and major regional political violence (lregint). The results overwhelmingly concluded that it is not cross sectionally independent, thus, we rejected the null hypothesis ( $H_0$ : Cross sectionally independent) at 1% level.

Since the results of the cross sectional dependence test showed that the panel data are found to be cross sectionally dependent, we proceeded with the second generation panel unit root test, albeit the test proposed by Pesaran (2003) and as written by Pesaran (2003). It 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). Also considered was the truncated version of the CADF statistics which has finite first and second order moments. It allows the avoidance 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 cross-section 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 Akaike model selection criteria. An additional information from Pesaran (2003) is that in the case of unbalanced panels, only standardized  $Z[t\text{-bar}]$  statistics can be computed (the reason why only standardized  $Z[t\text{-bar}]$  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 fractions of the series are stationary.

From Table 2 it can be safely concluded that at 1% level of significance, the Pesaran CADF test revealed 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.

Preceding the results obtained, and since all series are I(1), we employed the four panel error correction

TABLE 2. Pesaran CADF unit root test results

Variable	Level	1 <sup>st</sup> 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 parenthesis[ ]

based cointegration test developed by Westerlund (2007). The underlying idea is to test for the absence of cointegration by determining on the existence of 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. Since our data are 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 the degree of freedom, we analyzed the two models separately. Model 1 consists of 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 consists of income level (lgdpc), inflation (linf), interest rate/lending rate (lint), inequality (lineq), unemployment (lunemp) and regional political violence (lregin) as the independent variables.

From the following Table 3, we can conclude that the results are quite robust even 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

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]	-.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 10% level, 5% level and 1% level respectively, standardized Z[t-bar] statistics in parenthesis[ ]



United States of America). Based on the significant error correction term and based on the Granger Representation theorem (Engle and Granger (1987)), it implies that the error correction term will be significant if cointegration exist. Hence, we could conclude that cointegration exists between crime incidence and the regressors.

As a group, as per the result displayed in Table 4 above, all the independent variables are showing the same sign of coefficients even though they are not identical. Income and domestic political violence have negative relationship with crime incidence while all the other regressors have positive relationship. Meanwhile, the second model's results are 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. Domestic political violence and regional political violence were used interchangeably due to the constraints of the estimator which only allows for 6 covariates, the results seemed to be consistent. In the following paragraphs, an elaborate summary on each of the independent variable is given.

TABLE 4. Estimated long-run relationship

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]*

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

CRIME AND INCOME

It is a widely believed that income is as one of the major macroeconomic variables 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. However, Chisholm and Choe (2005) claimed that studies linking crime and income often produced mixed or contradictory results; thus their relationship is

ambiguous. It is important to note that there are a number of other studies which found strong cointegration or long run relationship between these variables.

As mentioned by Becker (1968), when a nation's economy becomes stronger, improvements in legitimate labor market opportunities make crime relatively less attractive, concluding that improved economic condition (better income level) will reduce crime. Another important study that is consistent 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 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 the angle we are looking from. The notion is that: it is either a persistent increase in level of prices; or persistent decline in the purchasing power. Nonetheless, it is safe to conclude that it will burn a hole in the pocket of consumers, who 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 lifestyle they are used to. One of earliest literature on this matter 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 scenarios 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 find that they strikingly moved in tandem, and true to our expected sign of inflation on crime, we find a positive relationship between crime and inflation throughout our three estimation (total, transition and developed). Previous

similar studies that linked inflation and crime, and 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 agreement with our finding where unemployment being positively related to crime. One of the main effects of being unemployed, is the lost of source of income. It will be almost impossible to cater to the needs of a normal life. This will add enormous strain to the life of a person, which we believe would push him 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 by Chiricos (1987) and Raphael and Winter-Ebmer (2008). Further supporting literature, the study by Rupert et al (2008), illustrated that the unemployed have the highest propensity to commit crime compared to 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 increases in crime rate. In studies regarding the United States of America, both studies by Neustrom et 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 to the different classes; a worsening distribution (increasing inequality) will increase the strain, and vice versa. As expected, we obtained a positive relationship between inequality and crime. This is another aspect of this study which concurs with almost all the studies. A 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). Meanwhile 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 policies (which indirectly influence income inequality) have impact on crime. Madden and Chiu (1998) reiterated that it seems reasonable to expect that the level of property crime will be influenced in some ways by the distribution of income.

#### CRIME AND INTEREST RATE (LENDING RATE)

It is rare for studies of determinants of crime to include interest rate as one of their independent variables. However we have it included since we believe it is closely related to crime. This is because high interest rate will be burdensome to debtors and might entice them to commit crime; and vice versa, where lower interest rate will provide them with an alternative to venture into something legal and meaningful. Thus, for that reason the interest rate chosen is the lending rate; and true to our notions and presumptions, we find 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 tend to create chaotic situations leading to occurrence of 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 remained no matter which variable was used; the sign of the other coefficients also remained 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. As far as we are aware no comparison could be made with previous literature since we are the only ones who 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 flee out of the country. These people may possibly commit crime in another country which probably explains the positive relationship between regional political violence and crime.

#### CONCLUSION

A number of important findings are extracted from the analysis. The most important is the determination and confirmation of the negative long run relationship between income and crime. This is where high income allows people to enjoy a better life; and vice versa when 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 are almost the same; higher prices benefit the firms and businesses whereby they received much higher return and profit. However for a majority of people, who are actually fixed-income earners, would definitely feel the pinch due to higher prices which translate to worsening purchasing power; again, this of which will induce strain.

On the other hand, the same relationship between unemployment and crime applies in the relationship between lending rate and crime. Losing source of income means one has to seek elsewhere in order to survive; but 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 erupts, people will be fleeing away, thus the logic of the negative sign. At the same time, whenever there is regional political violence, outsiders proliferate the country, and this 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 studies.

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

## REFERENCES

- Agell, J. & Nilsson, A. 2003. Crime, Unemployment and labor market programs inturbulent times. *IFAU Working Paper*.
- Baharom, A. H. & Habibullah, M. S. 2008. Crime and income inequality: The case of Malaysia. *Journal of Politics and Law* 2(1):55-70.
- Bai, J. & 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* 12.
- Chisholm, J. & 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. & Granger, C. W. J. 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*. New York: McGraw-Hill.
- Habibullah, M. S. & Baharom, A. H. 2008. Crime and economic conditions in Malaysia: An ARDL bounds testing approach. *International Journal of Social Economics* 36(11): 1071-1081.
- Habibullah, M. S. & Law, S. H. 2007. Crime and financial economic variables in Malaysia: Evidence from a vector error-correction model. *Journal of Social and Economic Policy* 4(2): 295-308.
- Hale, C. 1998. Crime and the business cycle in post-war Britain revisited. *British Journal of Criminology* 38(4): 61-698.
- Imrohorglu, A., Merlo, A. & Rupert, P. 2006. Understanding the determinants of crime. *Journal of Economics and Finance* 30(2): 270-283.
- Im, K. S., Pesaran, M. H. & 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 Criminology* 17(4): 377-390.
- Lo, T. W. & 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. & Wu, S. 1999. A comparative study of unit root tests with panel data and new simple test. *Oxford Bulletin of Economics and Statistics* (Special Issue): 631-652.
- Madden, P. & Chiu, W. H. 1998. Burglary and income inequality. *Journal of Public Economics* 69: 123-141.
- Masih, A. M. M. & 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. & Winkelmann. 1999. Unemployment and crime: New evidence for an old question. *IZA and Centre for Economic Policy Research*: 1-16.
- Persyn, D. & Westerlund, J. (2008). Error Correction Based Cointegration Tests for Panel Data. *Stata Journal* 8(2): 232-24.
- Pesaran, M. H., Shin Y. & Smith, R. P. 1999. Pooled mean group estimation of dynamic heterogeneous panels. *American Statistical Association* 94(446): 621-634.
- Pyle, D. J. & Deadman, D. F. 1994. Crime and the business cycle in post-war Britain. *British Journal of Criminology* 34(3): 339-357.
- Seals, A. & 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.

Baharom Abdul Hamid  
Taylors Business School  
Taylors University  
Subang Jaya, 47500  
Selangor D.E.  
MALAYSIA  
baharom.abdulhamid@taylors.edu.my

Muzafar Shah Habibullah  
Faculty of Economics and Management  
Universiti Putra Malaysia  
Serdang, 43400  
Selangor D.E.  
MALAYSIA  
muzafar@upm.edu.my

Zaleha Mohd Noor  
Faculty of Economics and Management  
Universiti Putra Malaysia  
Serdang, 43400  
Selangor D.E.  
MALAYSIA  
lehnoor@econ.upm.edu.my