Is crime cointegrated with income and unemployment?: A panel data analysis on selected European countries

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ABSTRACT

This paper examines the causality between income, unemployment and crime in 11 European countries employing the panel data analysis for the period 1993-2001 for both aggregated (total crime) and disaggregated (subcategories) crime data. Fixed and random effect models are estimated to analyze the impact of income and unemployment on total crime and various disaggregated categories of criminal activities. Hypothesis tests show that random effect model should be used for all (namely total crime, motor vehicle crime, domestic burglary, and violent crime) except for drug trafficking. Our results indicate that both income and unemployment have meaningful relationship with both aggregated and disaggregated crime. Crime exhibits positive significant relationship with income for all the categories except for domestic burglary, whereby it is significantly negative relationship. Crime also shows positive significant relationship with unemployment except for violent crime, whereby it is significantly negative relationship. The results also show strong country specific effect in determining the crime level.

I. INTRODUCTION

Criminal and violent behaviors have become a major concern in recent years across the world. More and more researches are being conducted in various parts of the world; however it is being hampered by unavailability and inconsistency of crime data. Its relationship with macroeconomic variables is very much of interest of policy makers. It cannot be argued that crime is an utmost important subject of study; the fact that it is a global phenomenon whereby most nations and its citizen's are griped with fear due to the rising statistics of criminal activities. Crime results not only in the loss of property, lives and misery, they also cause severe mental anguish. Imrohoroglu et al. (2006) mentioned that according to the United Nations Interregional Crime and Justice and Justice Research Institute, people victimized by property crime (as a % of the total population) varied between 14.8% in New Zealand to 12.7% in Italy, 12.2% in U.K., 10.0% in U.S., and 3.4% in Japan. The possible explanations for cross country differences are many, ranging from distinct definitions of crimes and different reporting rates (percentage of the total number of crimes actually reported to the police), to real differences in the incidence of crime and even to different cultural aspects. It can even be contributed to 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).

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No matter how we look at it, it is still an utmost important subject due to its large impact on a psychological aspect as well as economical aspect. Its pernicious effects on economic activities and more generally on the quality of life of people contribute to the emerging fact that crime is merging as a priority in policy agendas worldwide. Due to the complexity of the phenomenon and lack of consensus among policy makers or scholars, research on this issue continues to be conducted in many areas.

Unemployment is another prime concern for policy makers and it is often thought to be closely related with crime. Are they related? If yes, is it association or causation relationship? Many researches have attempted to answer the golden question; at best the results are mixed. Agell and Nilsson (2003), and Papps and Winkelmann (1999) are examples of studies which found strong positive relationship between unemployment and crime, while Chisholm and Choe (2005) reiterated that there is ambiguity in the empirical studies of crime economics regarding various income variables used to proxy the expected net gains from crime and as a result empirical findings are often mixed or contradictory to one another. Levitt (2001) emphasized that national-level time series data are an extremely crude tool for answering criminological questions like this research question. In an extensive analysis of aggregate research, Chiricos (1987) finds that unemployment has a statistically significant positive effect on property crime in 40 percent of the studies, while the effect on violence is only statistically significant positive in 22 percent of the study.

Crime rates vary enormously across countries and regions, so does unemployment which varies enormously even among selected European countries of this study, averaging for the period of 1993-2001, as low as 3.09% (Cyprus) to as high 15.62% (Finland). Other averages are 8.23% (Denmark), 10.18% (Estonia), 11.60% (France), 10.59% (Greece), 8.69% (Hungary), 5.29% (Netherlands), 4.17% (Norway), 6.74% (Sweden), and 3.74% (Switzerland). Arguably, crime literature originally proposed by Becker (1968) and Ehrlich (1973) have been considered as the most important seminal work in rejuvenating the interest in crime studies. Cost of living and hardship due to loss of employment are normally and widely considered to be closely related to level of criminal activities. Many economists agree that they do contribute in making problems like poverty and crime more intractable and undermines the political base of democratic capitalism.

The impact of crime on an economy can be segregated into, primarily the prevention cost, and secondarily the correctional cost and the lost opportunity of labor being held in correctional facility. Costs acquainted with crime preventions, such as private investment for crime prevention gadgets such as anti theft or anti burglary equipments, or government expenditures such as campaigns and education on safe society and police personnel expenditure. The correctional cost refers to cost such as correction facilities cost and prison personnel, while the lost opportunity refers to the lost of potential labor contribution due to being in correction facilities.

Madden and Chiu (1998) mentioned that it seems reasonable to expect that the level of property crime will be influenced in some way by the distribution of income (and wealth) while Teles (2004) reiterated that monetary and fiscal policies have impacts on crime. While there are a significant number of studies linking income inequality to crime such as Fajnzylber et al. (2002a, 2002b), Chisholm and Choe (2005), Imrohoroglu et al. (2006), Choe (2008), Lorenzo and Sandra (2008), Magnus and Matz (2008), to name a few, this paper would attempt to link income level (real GDP per capita) to crime.

This paper is organized as follows. In the next section we discuss some prior evidence on the effect of income and unemployment on aggregated and disaggregated criminal activities. In section 3, we present the panel data analysis using the random and fix effect model and also the Hausman test to choose the appropriate model. Finally in section 4, we discuss the empirical results and the last section contains our conclusion.

II. A REVIEW OF RELATED LITERATURE

As explained in the early part of this paper, it cannot be denied that the seminal paper by Becker (1968) and Ehrlich (1973) have been considered as the most important work in rejuvenating the interest in crime studies. While Becker (1968) emphasizes on the cost and benefit of crime, Ehrlich (1973) extends Becker's crime model by including the role of opportunity cost between illegal and legal work. Poutvaara and Priks (2007) examine a model of criminal gangs and suggest that there is a substitution effect between property crime and violent crime. They further explained that unemployment increases the relative attractiveness of large and less violent gangs engaging more in property crime. Papps and Winkelmann (1999) found some evidence of significant effects of unemployment on crime both for total crime and for some subcategories of crime in their analysis that covered sixteen regions over the period 1984 to 1996 in New Zealand.

As for the relationship between income and crime, Hipp (2007) using a unique nonrural subsample from a large national survey (the American Housing Survey) found that higher income reduces disorder but increases crime, while Fedderke and Luiz (2008) in their study on South Africa found that rising income lower political instability, in turn it increases crime rates. Both authors concluded that there exist meaningful positive relationship between income and crime. Gould et al. (2002) also concluded that both wages and unemployment are significantly related to crime, but that wages played a larger role in the crime trends over the last few decades.

Narayan and Smyth (2004), in their study on Australia, employing Granger causality test, to examine the relationship between seven different categories of property crime and violent crime against the person, male youth unemployment and real male average weekly earnings from 1964 to 2001 within a cointegration and vector error correction framework. It is found that fraud, homicide and motor vehicle theft are cointegrated with male youth unemployment and real male average weekly earnings. However, there is no evidence of a long-run relationship between either break and enter, robbery, serious assault or stealing with male youth unemployment and real male average weekly earnings. On the contrary, Habibullah and Law (2007) also utilized Vector Error Correction Model (VECM) in their study about crime and financial economic variables in Malaysia, and generally their result suggests that criminal activity in Malaysia cannot be explained properly by real income per capita, financial wealth and interest rate.

Magnus and Matz (2008) went a step further whereby they separated the effects of permanent and transitory income, diverting from the traditional aggregated measures. They reported that while an increase in inequality in permanent income yields a positive and significant effect on total crimes and property crimes, an increase in inequality in the transitory income and traditional aggregated measures yields insignificant effect.

III. OVERVIEW OF CRIME RATES GROWTH IN THE SELECTED EUROPEAN COUNTRIES

Table 1 to Table 5 illustrates the crime statistics by various categories of crime selected, such as total crime, motor vehicle theft, domestic burglary, violent crime and drug trafficking in the selected European countries namely, Cyprus, Denmark, Estonia, Finland, France, Greece, Hungary, Netherlands, Norway, Sweden and Switzerland. It can be observed from Table 1 that the average percentage growth varies from -3.2% (Switzerland) to 3.6% (Estonia) with the European Union average standing at -01%, as from Table 2, which is the average growth of violent crime, the observed pattern is that it varies from -3% (Finland) to 15% (France) with the European Union average standing at 5%. Table 3, the average growth of domestic burglary, it is from -21% (Cyprus) to 13% (France) with the European Union average standing at 0%. While Table 4, the average growth of theft of motor vehicle, it varies from - 14% (Finland) to 21% (Estonia) with the European Union average standing at -7% and finally Table 5, the average growth of drug trafficking, it varies from -5% (France) to 105% (Estonia) with the European Union average standing at 6%. It can be clearly seen that the trends differ across categories and countries with the largest variance being drug trafficking.

Reiterating what have been said in the early part of this paper, these differences might be due to many aspects, ranging from distinct definitions of crimes and different reporting rates (percentage of the total number of crimes actually reported to the police), to real differences in the incidence of crime and even to different cultural aspects. It can even be contributed to 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).difference in the sentence melted out for each of the crime categories, culture or as

IV. METHODOLOGY

A panel dataset has multiple observations on the same economic units and each element has two subscripts, the group identifier i (in this case the countries) and within group index denoted by t which identifies time (in this case 1993-2001). Given panel data, several models can be identified arising from the most general linear representation:

$$Y_{it} = \sum_{i=1}^{m} x_{it}\beta_{kit} + \mu_{it}, \ I = 1,\ldots\ldots.,N, \ t=1,\ldots.,T \tag{1}$$

where N is the number of individuals(countries) and T is the number of periods.

We could ignore the nature of the panel data and apply pooled ordinary least squares, which would assume that $\beta = \beta_j \ \forall \ j,i,t,$ but the model might be overly restrictive and can have a complicated error process such as heteroskedasticity across panel units, serial correlation within panel units etc. Random-effects model and fixed effects model allow for heterogeneity across panel units (and possibly across time) but confines the heterogeneity to the intercept terms of the relationship by imposing restrictions on the above model of $\beta = \beta_j \ \forall \ j,i,t, \ j > 1,$ thereby allowing only the constant to differ over i. The structure represented in model (1) may be restricted to allow for heterogeneity across units without the full generality (and infeasibility) that this equation implies. In particular, we might restrict the slope coefficients

that vary to be constant over both units and time and allow for an intercept varying by unit or by time (Baum, 2006).

For a given observation, an intercept varying over units results in the structure:

$$Y_{it} = x_{it}\beta_k + Z_i\delta + \mu_i + \acute{\varepsilon}_{it} \tag{2}$$

where $\mathbf{x_{it}}$ is a 1 X k vector of variables that vary over individual and time, β is the k X 1 vector of coefficients on $\mathbf{x}$, $\mathbf{z_i}$ is a 1 X p vector of time-invariant variables that vary only over individuals, $\boldsymbol{\delta}$ is the px1 vector of coefficient on $\mathbf{z}$, μ_i individual-level effect, and $\acute{\varepsilon}_{it}$ is the disturbance term. The μ_i are either correlated or uncorrelated with regressors in $\mathbf{x_{it}}$ and $\mathbf{z_i}$. The μ_i are always assumed to be uncorrelated with $\acute{\varepsilon}_{it}$). If the u_i are uncorrelated with the regressors, they are khown as RE, but if the u_i are correlated with the regressors, they are known as FE. The origin term of RE is clear: when u_i are uncorrelated with everything else in the model, the individual effects are simply parameterized as additional random disturbance. The sum $\mu_i + \acute{\varepsilon}_{it}$ is sometimes referred as the composite error term. On the other hand, the origin term of FE is more elusive. When u_i are correlated with some of the regressors in the model, one estimation strategy is to treat them like parameters of FE, but simply including a parameter for every individual is not feasible, because it would imply an infinite number of parameters in large N sample. Hausman test to test the null hypothesis that the extra orthogonality conditions imposed by the RE estimator are valid. This test uses the difference of the two estimated covariance matrices (which is not guaranteed to be positive definite) to weight the difference between FE and RE vectors of slope coefficients). In short the hypothesis is as below;

H_0 : RE estimator is valid
H_A : RE estimator is invalid

Sources of Data

Data for the aggregated crime and disaggregated subcategories of crime for the eleven selected European countries, for the corresponding period (1993-2001) was obtained from Home Office Statistical Bulletin 12/03, Home Office, United Kingdom. As for the data on Real GDP per capita, which was used as a measurement of income, and unemployment rate for the countries mentioned above was obtained from IMF/IFS Statistics CDROM 2007. Categories selected are total crime, motor vehicle crime, domestic burglary, drug trafficking and violent crime. Throughout the analysis, all variables were transformed into natural logarithm.

V. THE EMPIRICAL RESULTS

The results of the Panel data analysis, employing the FE and RE models are displayed in Table 6. The results are very clear; both the regressors are overwhelmingly significant and have meaningful relationship across categories of crime. After the Hausman Test was conducted, it is found that the RE model is more appropriate in all the equations except for drug trafficking or in other words, the u_i are uncorrelated with the regressors. As for the sign of the regressors, unemployment have a positive relationship with total crime, drug

trafficking, motor vehicle crime, domestic burglary and negative relationship with violent crime. As for income, it has a positive relationship with total crime, violent crime, drug trafficking and motor vehicle crime. It has a negative relationship with only domestic burglary. These results are very consistent in nature. Generally it also shows that there is a strong and unique country effect.

VI. CONCLUSION

In this study the Panel data Analysis using the fixed and random effect approach bundled with Hausman test was employed to investigate the relationship between income, unemployment and various categories of crime namely total crime, domestic burglary, violent crime, drug trafficking and motor vehicle theft. The sample period was 1993 – 2001 and the data was annual, covering selected eleven European countries. All the data went through log-log transformation so that the estimates will be less sensitive to outliers or influential observations and also in order to reduce the data range.

The results suggest that both the variables chosen as regressor are significant in determining the level of criminal activities. The results are consistent and concurrent with the finding of Agell and Nilsson (2003), and Papps and Winkelmann (1999) whose studies all found strong positive and significant relationship between unemployment and crime. As for the negative relationship between unemployment and violent crime, it is also consistent, whereby as explained by Poutvaara and Priks (2007), it is due to substitution effect in their studies which examined a model of criminal gangs. They further explained that unemployment increases the relative attractiveness of large and less violent gangs engaging more in property crime. The results of this paper suggests an explanation to the empirical regularity whereby unemployment tends to increase property crime, but not violent crime same sentiments are also shared Becker (1968) who emphasizes on the cost and benefit of crime, and Ehrlich (1973) who extends Becker's crime model by including the role of opportunity cost between illegal and legal work. It also does explain the negative relationship between income and domestic burglary.

As for the positive relationship between income and crime (except for domestic burglary) It is also inline with the finding of Hipp (2007) who found that higher income reduces disorder but increases crime, and Fedderke and Luiz (2008) who found that rising income lower political instability , in turn it increases crime rates. Another agreeing study is that of Narayan and Smyth (2004), in their study on Australia found that fraud, homicide and motor vehicle theft are cointegrated with male youth unemployment and real male average weekly earnings. Gould et al. (2002) also concluded that both wages and unemployment are significantly related to crime, but that wages played a larger role in the crime trends over the last few decades

This study was able to find significant and meaningful relationship between income, unemployment and various categories of crime namely total crime, domestic burglary, violent crime, motor vehicle crime and drug trafficking, it is still an important finding. It shows that for the case of the eleven European countries, crime is closely related with macroeconomic variables and from a policy perspective, when initiating crime reduction policies, the respective governments should see tit from a bigger picture to encompass other socioeconomic factors that could be part of broader system of crime causation. The authors would also like to suggest more researches to be done on other parts and other macroeconomic variables as well.

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Table 1 Total Crimes recorded by the police (percentage changes)

Country			1991-2001	1997-2001	2000-2001	1991-2001
European Union average			*-1%*	*4%*	*3%*	*-0.1%*
Cyprus			25%	16%	4%	2.2%
Denmark			-9%	-11%	-6%	-0.9%
Estonia			84%	43%	1%	6.3%
Finland			-7%	-3%	-6%	-0.7%
France			8%	16%	8%	0.8%
Greece			22%	16%	19%	2.0%
Hungary			6%	-9%	3%	0.6%
Netherlands			13%	10%	4%	1.2%
Norway			28%	5%	-2%	2.5%
Sweden			-1%	-1%	-2%	-0.1%
Switzerland			-28%	-28%	2%	-3.2%

Source: Home Office Statistical Bulletin 12/03, Home Office, United Kingdom

Table 2 Crimes recorded by the police: Violent crime

Country	% change 1997-2001	% change 2000-2001
European Union average	*22%*	*5%*
Cyprus	-4%	7%
Denmark	15%	2%
Estonia	-18%	-5%
Finland	7%	-3%
France	50%	15%
Greece	8%	4%
Hungary	14%	6%
Netherlands	35%	11%
Norway	10%	-1%
Sweden	12%	3%
Switzerland	16%	6%

Source: Home Office Statistical Bulletin 12/03, Home Office, United Kingdom

Table 3 Crimes recorded by the police: Domestic burglary

Country	% change 1997-2001	% change 2000-2001
European Union average	*-10%*	*0%*
Cyprus	-26%	-21%
Denmark	-7%	-2%
Estonia	16%	5%
Finland	-24%	-14%
France	-1%	13%
Greece	-28%	0%
Hungary	-16%	-3%
Netherlands	-6%	1%
Norway	-39%	-7%
Sweden	-17%	-14%
Switzerland	-31%	-5%

Source: Home Office Statistical Bulletin 12/03, Home Office, United Kingdom

Table 4 Crimes recorded by the police: Theft of a motor vehicle

Country	% change 1997-2001	% change 2000-2001
European Union average	*-7%*	*-7%*
Cyprus	-10%	16%
Denmark	-31%	-13%
Estonia	60%	21%
Finland	3%	-14%
France	0%	4%
Greece	-17%	-4%
Hungary	-39%	-13%
Netherlands	-6%	-9%
Norway	3%	-12%
Sweden	-7%	-2%
Switzerland	..	..

Source: Home Office Statistical Bulletin 12/03, Home Office, United Kingdom

Table 5 Crimes recorded by the police: Drug trafficking

Country	% change 1997-2001	% change 2000-2001
European Union average	*4%*	*6%*
Cyprus	62%	34%
Czech Republic	-20%	-41%
Denmark	-2%	-27%
Estonia	1993%	105%
Finland	79%	11%
France	-51%	-5%
Greece	62%	25%
Hungary	1580%	48%
Netherlands	-24%	39%
Norway	32%	11%
Sweden	-32%	-7%
Switzerland	-8%	-1%

Source: Home Office Statistical Bulletin 12/03, Home Office, United Kingdom

Table 6 Panel Data Result

Categories of Crime	Real GDP per capita	Unemployment	Hausman Test	Appropriate Model		R-square	
			(p value)		within	between	overall
Total Crime	0.6982***	0.2220***	0.4123	RE	0.4055	0.2921	0.2936
	(0.0985)	(0.0371)					
Violent Crime	0.34019***	-0.1966***	0.4925	RE	0.4012	0.0922	0.0951
	(0.1072)	(0.0394)					
Domestic Burglary	-0.2540***	0.1861***	0.1508	RE	0.1958	0.054	0.0367
	(0.1524)	(0.0645)					
Motor Vehicle Crime	0.6686***	0.2525***	0.7635	RE	0.1019	0.5307	0.5128
	(0.1805)	(0.0872)					
Drug Trafficking	7.0404***	1.0627***	0.0000	FE	0.6312	0.4398	0.4098
	(0.5804)	(0.2061)					

Note: * , ** , and *** denotes statistically significant at 10%, 5% and 1% respectively. The value in parenthesis [] are standard error values