

THE RELATIONSHIP BETWEEN OCCURRENCE OF CRIME AND ECONOMIC GROWTH IN THE EUROPEAN UNION: PANEL VAR APPROACH

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Abstract

This study is to evaluate the relationship between crime and economic growth in 27 countries of the European Union in the period of 2004–2014. By using GMM estimators to estimate Panel Var model and Granger causality test, shock effects of crime occurrence on economic growth in these countries are analyzed. Control variables including government expenditure on education, total (% of GDP), investment per capita and population have also been used. Based on the gain results economic growth in relationship to crime occurrence has a significant reaction, but in a negative way, though after a shock on economic growth, crime would have a positive effect.

The reason for this can be found in Kuznets curve. Due to the fact that in the early stages of economic growth, there is more income inequality and income inequality leads to crime occurrence, over time the impact of crime on economic growth has decreased and has reached from 9% in the first period to 6.5% in the second. Therefore, the attendance of new countries of East Europe in the EU, by considering the high average of crime in them, can be a threat to the economic growth of other members of the union.

Key words: *Crime, Economic Growth, Panel Var*

JEL Classification: *04, K14, C33*

Introduction

Crime is an act or an instance of negligence which is against the law and is punishable. A crime against a person includes any threat of force or using force (Ojog, 2014). Crimes can be divided into 5 categories;

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Violent and property crimes, organized, corporate, white collar and without victims (Geis & Jesilow, 1982).

On the one hand, criminal activities would lead to consumption of illegal goods and services and this would impose heavy costs on private and public sectors (Detotto & Otranto, 2010). Crime is a costly act because it follows by dispossession risk.

In terms of institutional economics, appropriate institutions will reduce transaction costs and cause better economic performance (Mantazavinos, North & Shariq, 2004) therefore crime occurrence which reduces the level of security can weaken economic performance.

Since the 1960s, the economic literature related to crime in the two areas of theoretical and practical has a significant development. The major expansion of this literature is based on the paradigm of Gary Becker which shows individual decision for crime occurrence based on an analysis of cost – benefit (Lederman, Loayza & Menendez, 2002).

Review the social costs that crime imposes on society in recent decades has become a major issue in the economic literature (Czabansky, 2008). In studies such as Brand and Price (2000) and Anderson (1999), calculating the social costs of crime and its ratio to total GDP, respectively, in the United Kingdom and the United States is discussed.

Detotto and Vannini (2010) by studying the Italian economy in 2006 reached to this conclusion that the ratio of social cost of crime to GDP is 2.6%. Although many studies have been done on the social costs of crime, regarding the effect of crime on economic growth, there has been some negligence (Detotto et al., 2010). Among the many studies done in Italy, Peri (2004), Mauro and Carmeci (2007) and Detotto and Pulina (2013) can be mentioned. A number of studies have been done about the relationship between companies' growth and crime in Latin America. (Gaviria, 2002; BenYishay & Pearlman, 2014).

In many studies, the importance of the positive impact of social capital which can be known as a set of rules, norms, obligations and

institutionalized trust, on economic growth has been emphasized (Coleman, 1988; Puntam, 2001; Papagapitos & Riley, 2009, Bjornskov, 2012). Crime can affect social capital (Rosenfeld, Messner & Baumer, 2001). Violent crime by reducing trust among members of society or increasing the formation of social institutions to tackle crime will cause a social capital reduction (Lederman et al., 2002). So, crime occurrence by reducing social capital will cause decreasing in economic growth.

Despite the great efforts that have been made of the influence of crime on economic growth but one cannot firmly speak about the impact. Some studies emphasize on the negative impact of crime on economic growth (Cárdenas & Rozo, 2008; Gaibullov & Sandler, 2008). Some believe the uncertainty of this impact (Goulas & Zervoyianni, 2012; Burnham, Feinberg & Husted, 2004). Moreover, some studies even conclude that crime does not have an impact on economic growth (Mauro & Carmeci, 2007; Ray, 2009).

However, it is believed that criminal activities by reducing economic competitiveness, fear of foreign investment, transferring public and private resources to crime prevention activities can reduce the productive capacity of the economy (Neanidis & Papadopoulou, 2012).

To estimate crowding out effect of crime on economic growth, there are two approaches: The basic approach is based on a comparison between regions and countries and the second approach is based on the univariate and multivariate time series methods. In the first approach, the economic performance of countries and regions with various levels of crime is analyzed. In this study, considering that the study is done at the level of EU members, the first approach is used. In studies of Mauro (1995), Lambsdorff (2003), Peri (2004), For Ni and paba (2000), Gaibullov et al., (2008) panel data methods are used for estimating the effect of crimes such as corruption, murder and domestic and international terrorist operations have on economic growth.

Despite the growing literature on the relationship between crime and economic growth, this relationship between the two is still unclear.

(Goulas & Zervoyianni, 2015) In order to study the interactions VAR models in analyzing this relationship can be useful. Given that the data used in this article is a type of panel data the methodology of VAR model is used. The hypothesis of this article is based on the object that there is a mutual negative causal relation between economic growth and crime. In this article, the data of 27 country members of the EU² in the years of 2004-2014 are used. In the second section, the methodology and the data are pointed out. In the third section, the experimental results of estimation model and in the fourth section the policy implications are discussed. In the last section a brief summary of article with concluding remarks are mentioned.

Methodology

We are using panel-data vector autoregression methodology. In this type of model we combine the traditional approach of VAR (endogenous variables) with panel data approach that shows unobserved individual heterogeneity of variance (Love & Zicchino, 2006). Methods of VAR model estimation change in accordance with the combined data. Therefore this data is classified in two categories of micro and macro:

- A. Microeconomic data with high N and low T
- B. Macroeconomic and financial data with big N and T.

T indicates the size of the time-series and N indicates the number of sections (Canova & Ciccarelli, 2013).

The data used in our model with T=11 and N = 27 are of the first series. For the first time Holtz-Eakin, Newey, and Rosen (1988) studied VAR model in terms of small time-series. Although in these models the

² Europe Union consist of 28 countries .Cyprus has been removed in this study.
Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

size of time-series is small but this does not mean that the data cannot be accumulated or unsteady. Another thing that should be considered is the violation of compatibility assumptions of Quasi Maximum Likelihood (QML) in using the fixed effects model (Neyman, & Scott, 1948.)

For this purpose standard Generalized Method of Moments (GMM) (Arellano, & Bond, 1991; Holtz-Eakin et al., 1988), developed Generalized Method of Moments (Ahn & Schmitt, 1995; Arellano & Bover, 1995; Blundell & Bond, 1998) and - Fixed effect- Quasi Maximum Likelihood (FE-QML) and Random effect- Quasi Maximum Likelihood (RE-QML) (Binder, Hsiao & Pesaran, 2005) are represented.

VAR model is displayed as follows:

$$+\beta'(L)X_{it} + \theta_i + \varepsilon_{it} \quad (1) Y_{it} = \sum_{j=1}^p \alpha_j Y_{i,t-j}$$

ε_{it} , error term has zero mean but there could be heterogeneity of variance between sections and time periods. θ_i Shows sectional effects (Regardless of time). X_{it} is predefined variables as the dependent variable lag is predefined. Y_{it} is economic growth or crime. The problem in estimating model (1) is the relationship between dependent Individual Effect with the explanatory variables. This causes the OLS estimators to be biased and inconsistent, therefore we use first-difference estimator (Huang, Hwang & yang, 2008):

$$\Delta Y_{it} = \sum_{j=1}^{p-1} \alpha_j Y_{i,t-j} + \beta'(L) + \Delta X_{it} + \Delta \varepsilon_{it} \quad (2)$$

Δ is the lag operator. Equation (2) solves the problem of the relationship between the dependent variable lags with error term, but also creates another problem: dependency between the variable with lagged dependent variable and error term. Therefore OLS would be biased and inconsistent again. As a result, as it has been mentioned before by using lagged dependent variable ($Y_{i,t-s}; s \geq 2$) as an instrument and GMM estimator the second problem will also be solved (Arellano et al., 1991).

Therefore Z_i matrix with predefined regressor X_{it} dependent on individual effects is formed as follows:

$$Z_i = \begin{matrix} Y_{it} & X_{i1} & X_{i2} & 0 & 0 & 0 & 0 & 0 & \dots & 0 & \dots & 0 \\ 0 & 0 & 0 & Y_{i2} & Y_{i2} & X_{i2} & X_{i2} & X_{i3} & \dots & 0 & \dots & 0 \\ \dots & \dots \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \dots & Y_{i1} & \dots & Y_{i(T)} \end{matrix} \quad (3)$$

In equation (3), lines are related to first-order differential equation (2) for time periods of $t= 3,4,\dots, T$ for section i , which provides torque characteristics:

$$E [Z_i' \Delta \varepsilon_i] = 0 \quad \text{for } i=1, 2, \dots, N \quad (4)$$

Estimating $\Delta \varepsilon_i = (\Delta \varepsilon_{i3}, \Delta \varepsilon_{i4}, \dots, \Delta \varepsilon_{iT})'$ while $Z_i =$ which is made based on torque characteristics of GMM, minimize our criterion:

$$J_N = \left(\frac{1}{N} \sum_{i=1}^N \Delta \varepsilon_i' Z_i \right) W_N \left(\frac{1}{N} \sum_{i=1}^N Z_i' \Delta \varepsilon_i \right) \quad (5)$$

Using the weight matrix:

$$W_N = \left[\frac{1}{N} \sum_{i=1}^N (Z_i' \widehat{\Delta \varepsilon}_i \widehat{\Delta \varepsilon}_i' Z_i) \right]^{-1} \quad (6)$$

$\Delta \varepsilon_i$ are consistent estimators of first difference wastes. This method is known as two-step GMM estimator. By the assumption of homogeneity of the variance ε_{it} . First- differenced model asymptotically shows the same result as one step GMM estimator by using alternative matrix bellow:

$$W_{1N} = \left[\frac{1}{N} \sum_{i=1}^N (Z_i' H Z_i) \right]^{-1} \quad (7)$$

H is a Square matrix (T-2) with number 2 on the diagonal, -1 on the first non-diagonal element and 0 in the rest points. W_{1N} is not dependent on any of the estimated parameters (Bond, 2002).

On using one step or two step model (Bond, 2002) believes that the dependency of two-step matrix on estimated parameters causes less reliability on estimates of the asymptotic distribution of normal two-step estimator. Therefore we are also using one-step estimator. The model which is used in this article can be seen as follows:

$$(GROWTH_{it}) = F (LNPOP, CAP, EDU, LNCRIME) \quad (8)$$

In this study, a VAR model with five variables has been estimated. $GROWTH_{it}$ is the real economic growth of each country, $LNPOP_{it}$ is the population logarithm of each country, CAP_{it} is each country's per capita investment in millions of dollars, EDU_{it} is the government expenditure on education, total (% of GDP), $LNCRIME_{it}$ is the time-series logarithm of the crime in each country. Economic growth in percentage and the data related to crime is number of intentional homicides per 100,000 people in each country. In Table (1) descriptive statistics of the data can be studied:

Table (1) - Summary Statistics for Variables

Variable	mean	media n	max	min	Sd	Source
$GROWTH_{it}$ (%)	1.78	2	11.9	-14.8	3.92	ec.europa.eu/eurostat ³
$LNPOP_{it}$	9.03	9.13	11.3	5.99	1.37	ec.europa.eu/eurostat
CAP_{it}	5.15	4.39	16.54	0.56	3.26	ec.europa.eu/eurostat

³ Website of Europe Statistics Commission

						rostat
(%) EDU_{it}	8.83	6.90	32.6	1.3	6.82	ec.europa.eu/eurostat
$LNCRIME_{it}$	0.23	0.18	2.4	-2.30	0.87	https://data.unodc.org ⁴

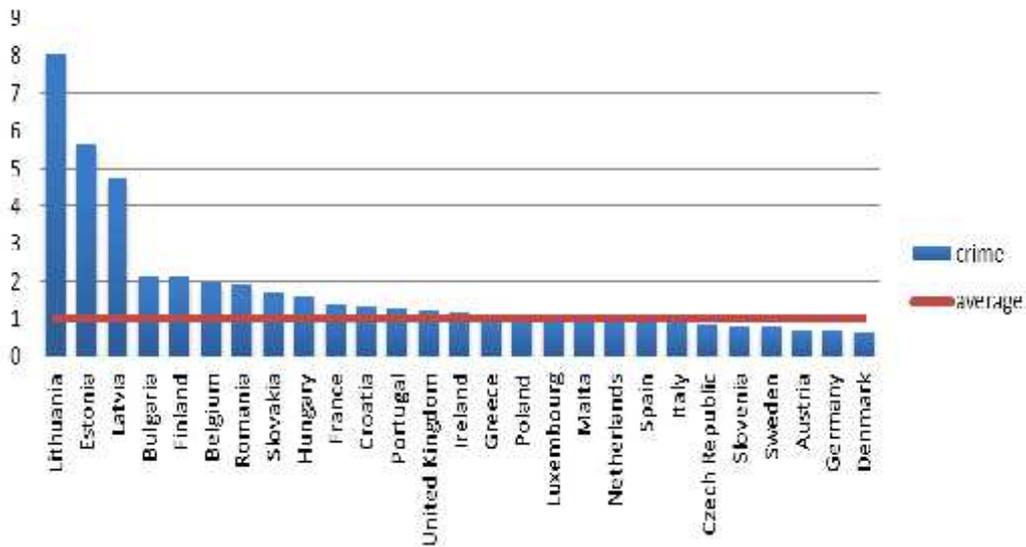
In the introduction section, there have been several mentioning of the studies related to the effect of crime on economic growth. There have been studies since long ago on the effect of population on economic growth. “The Essay on the Principle of Population” by (Malthus, 1978) one of the oldest attempts to explain the role of population in economic growth. There are different opinions about the relationship between population and economic growth. The ones who believe in a positive effect of population on economic growth are called optimistic theories, and the ones who represent the negative effect of population on economic growth are called pessimistic theories. There is also a third view which shows that the effect of population growth on economic growth is neutral, which are called neutrality of population (Andersson, 2001).

There have been discussions regarding the effect of capital accumulation on economic growth which in most neoclassical growth models is accepted as a principle (Solow,1956; Swan,1956; Cass, 1965). In various studies, it has been shown that education affects the possibility of crime occurrence (Meghir, Palme & Schnabel, 2012; Lochner & Moretti, 2004; Machin, Marie & Vujic, 2011). Over education as one of the elements of human capital which affect economic growth has been discussed in detail in various studies (Barro, 2001; Aghion, Bouston, Haxby & Vandenbussche, 2009) .

In diagram (1) the yearly average of crimes per 100,000 people in 27 country members of the EU, is shown in period of 2004-2014.

4 United Nations Office on Drugs and Crime

Diagram (1)- The Yearly Average of Crime Per 100,000 People In EU Countries(2004-2014)



It is shown in Diagram (1) that new members of the EU usually have higher crime occurrence and mostly are from Eastern Europe⁵. Therefore by joining the Eastern European countries the average of crime in the EU increased. Countries such as Latvia, Estonia, Lithuania and Bulgaria have higher crime average than the crime average in the EU.

Econometric analysis and results

The main goal of our empirical analysis is to test the causal relation between crime and economic growth. Our tests are Panel unit root test, Panel cointegration test, and Panel Granger causality test. Furthermore, in order to further analyze the interaction of crime on economic growth, impulse response functions and variance decomposition analysis are presented.

⁵ Poland, Hungary, the Czech Republic, Slovenia, Cyprus, Slovakia, Estonia, Latvia, Lithuania and Malta in 2004, Romania and Bulgaria in 2007 and Croatia in 2013 officially joined the EU.

Panel unit root test

In analyzing panel data in order to study the stationary feature of the variables, Panel Unit Root Test is necessary. There are several tests such as Im–Pesaran (IPS) ,Levin–Lin–Chu(LLC), and Maddala-WU(MW). Following Wang, Zhou, Zhou and (2010) Lean and Smyth and Wang (2011) we are also using these three tests.

LLC test is done by the assumption of shared root between all sections. However, due to serial correlation, it is not very powerful for small samples. IP test is better for testing small samples because of the assumption of separate unit root between each section. MW tests various lags by Augmented Dickey–Fuller (Wang et al., 2011). The null hypothesis of all three tests is generally defined as the presence of a unit root and being non-stationary. In the table (2) the results of the unit root test for all variables are shown:

Table (2) - Panel Unit Root Tests

Variable	MW test		IPS test		LLC test	
	First Difference	Level	First Difference	level	First Difference	level
GROWTH_{it}(%)	83.987***	77.678***	-1.171	1.271	5.601***	5.891***
LNPOP_{it}	71.726*	56.0191	-0.70305	0.162	-6.855***	5.778***
CAP_{it}	87.965***	51.097	2.289***	0.308	-20.899***	1.153
(%)EDU_{it}	117.132***	61.583	3.108***	0.482	-19.827***	4.050***
LNCRIME_{it}	61.975*	65.886*	-0.637	0.585	10.987***	7.811***

Source: Author’s calculations. –All the Panel Unit Root Tests are by including intercept and trend for are the variables. *, ** and *** respectively represent significance at 10%, 5% and 1%.

Considering the results in the table (2), it can be seen that all variables except CAP according to LLC test are statistically significant and don't have unit root. However, according to IPS and MW tests, most of the variables have unit root and are not stationary. Considering that LLC test in compare with the other two is more powerless it can be concluded that all variables are non-stationary at level. However, in first-difference, all variables are stationary according to the results of MW and LLC. Therefore, it can be concluded that all variables are integrated of order one or I (1).

Panel cointegration test

Considering all variables as I(1), there is a need for cointegration testing to verify the presence or absence of a long-term relation between the variables. There are different related tests such as WU Kao (1999) Pedroni (1999, 2004) and Maddala (1999); which we use the two more common tests of Kao and Pedroni because of their popularity. The results can be seen in the table (3).

Table (3)- Cointegration Tests

Pedroni				Kao	
Panel (Within dimension)		Group (between dimension)			
statistics	Value	statistics	value	statistics	value
v-Statistic	-4.254	rho-Statistic	6.985	ADF	-5.997***
rho-Statistic	5.010	PP-Statistic	11.064***		
PP-Statistic	-5.555***	ADF-Statistic	-7.111***		
ADF-Statistic	-4.701***				

Source: Author's calculations. *, ** and *** respectively represent significance at 10%, 5% and 1%.

The null hypothesis is based on no cointegration between variables. According to the results of Pedroni test in the cross-sectional panel, from the four resulting statistics, two of them confirm cointegration assumption. Considering that rho-Statistic has less power than PP-Statistic and most statistics confirms significance being of integration. Therefore the existence of cointegration is approved.

In cross-sectional group two of the three statistics reject the Null Hypothesis based on no cointegration. The resulted statistic from Kao test also confirms the cointegration between the variables. Considering the existence of integration of order one between the variables, using them in the model without differencing and at the level is possible.

Causal relation between crime and economic growth

In this section by using the Abrigo and Love (2015) we estimate the Panel Var model. In the first stage regarding studying Vector regression models, we determine the optimal lag based on the three criteria of choosing the model by Andrews and Lu (2001), which means MAIC (Akaike Information Criterion), MBIC (Schwartz Criterion) and MQIC (Hannan-Quinn Criterion). In the table (4) the results of determining the duration of optimal lag are presented.

Table (4) - Selection Order Criteria

lag	J pvalue	MBIC	MAIC	MQIC
1	0.14	-287.3389	-62.04291	-153.5769
2	0.25	-193.8984	-43.70111	-104.7238
3	0.88	-108.2679	-33.16924	-63.68058

According to the results of Table (4), first-order panel VAR is the preferred model because has the least MAIC MBIC and MQIC (Abrigo

et al., 2015). Hansen's J statistic is insignificant in all lags of level 10%. Due to this, we fit a first-order panel VAR model and estimate the model by using GMM estimator.

Table (5) shows the results of the model with five variables of GROWTH LNPOP CAP EDU LNCRIME. The results show that economic growth response to a crime momentum is negative. However, crime response to economic growth is positive. Economic growth also has a negative response to population and per capita investment. However, investment has a positive effect on economic growth according to theoretical expectations. According to the results in a table (5), economic growth has a positive and significant effect on crime. Population growth also has a positive effect on crime and investments do not have a significant effect on crime.

Table (5) – Main Results of 5-Variable VAR Model (GMM Estimator)

Response of	Response to				
	GROWTH _{t-1}	LNPOP _{t-1}	CAP _{t-1}	EDU _{t-1}	LNCRIM _{t-1}
GROWTH_t	0.959(10.63)***	-0.090 (-2.59)**	-0.050(-5.67)***	4.548(2.47)**	-3.545(-6.70)***
LNPOP_t	0.487(2.16)**	0.441(3.86)***	0.25(1.24)	16.063(3.58)***	-6.991(-4.72)***
CAP_t	1.810(4.01)***	0.437(3.07)***	0.612(9.70)***	-10.586(-1.09)	-8.053(-2.49)**
EDU_t	0-051(-5.51)***	0.010(3.11)***	-0.0009(-0.87)	0.005(0.03)	0.407(5.89)***
LNCRIME_t	0.068(8.06)***	0.007(2.36)**	0.001(1.03)	0.592(3.34)***	-069(-1.45)
No. of obs	232				
No. of panels	27				

Source: Author's calculations. Reported numbers show the coefficients of regressing the row variables on lags of the column variables. Z statistics is in parentheses. *, ** and *** respectively represent significance at 10%, 5% and 1%.

On the other hand between education and crime is a positive relationship. Crime on investment also has a significant and negative relationship. Although the causality is extracted from the results in Table (5), in order to estimate more accurately Granger causal relation is examined in Table (6). The results are similar to the table (5).

Table (6) – Granger Causality Results (Wald Test)

	GROWTH_t	LNPOP_t	CAP_t	EDU_t	LNCRIM_t
GROWTH_t	-	1.53**	16.056***	30.407***	64.966***
LNPOP_t	6.699**	-	9.403***	9.661***	5.561**
CAP_t	32.116***	1.537	-	0.754	1.058
EDU_t	6.088**	12.834	1.178	-	11.158***
LNCRIME_t	44.849***	22.315	6.189***	34.7***	-

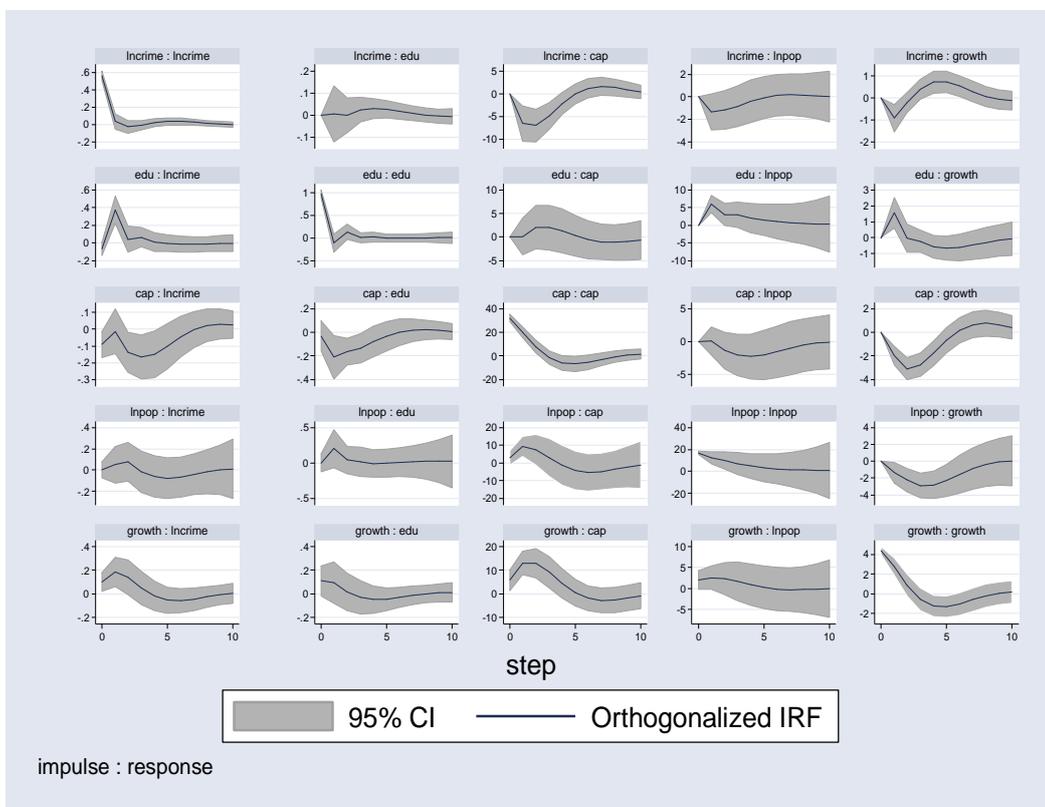
Source: Author's calculations – reported numbers in the table shows the Chi 2 statistics. Column variables are dependent and row variables are independent. *, ** and *** respectively represent significance at 10%, 5% and 1%.

According to the results, the hypothesis that crime has a negative effect on economic growth is confirmed. On the contrary, economic growth also affects crime.

Impulse Response Functions (IRFs)

Impulse Response Functions are usual tools that can be used in the analysis of interactions among variables. Based on VAR Model on Diagram (2) the impulse response functions are visible.

Diagram (2) -Impulse Response



Source: Author's calculations - Based On 1000 Monte Carlo simulations.

According to diagram (2), a shock in crime in the first period reduced economic growth, after that economic growth increases and reaches to a higher level than its initial and eventually returns to primary levels. However, the shock of economic growth in the first period caused

the positive response of crime, in subsequent periods decreased it and eventually reaches a level lower than the initial level.

Forecast error variance decompositions (FEVD)

Forecast error variance decompositions (FEVD) can help us to assess the relative importance of the shocks. Table (7) specifies that except economic growth that has the most important role in interpreting variation of itself, the capital has a clearly larger relative contribution in explaining the variation in economic growth after ten periods. Crime at the start of the shock has approximately 9% contribution to economic growth changes and after ten years it reaches to 6.5%.

Table (7)- Variance Decompositions

	GROWTH	LNPOP	CAP	EDU	LNCRIME
GROWTH	38.1	24.2	27.3	3.7	6.5
LNPOP	4.3	83.6	3.1	5.7	2.9
CAP	19.7	9.4	64.4	0.6	5.6
EDU	20.6	38.6	8.8	21.3	10.4
LNCRIME	12.8	4.5	9.3	12.1	61

Source: Author's calculations - The percentage (%) of row variables variation (after ten periods) which are explained by column variables. Based On 1000 Monte Carlo simulations.

The proportion of economic growth in variation of crime has reached to 12% at the end of period, although it was 1% at initial year. Among all variables, government expenditure on education, total (% of GDP), has lowest share in explaining economic growth variation after ten years. While at the beginning of a momentum in educational costs, the contribution is 5.6% and at the end of the period reaches to 7.3%.

Policy Implications

The investigation of the causal relationship between crime and economic growth has important policy implications. When crime in EU leads economic growth negatively, it suggests that policy makers should concentrate on non-economic factors influencing economic variables more than past. On the other hand, economic growth has a positive impact on occurrence of crime in EU. It means that although economic growth has positive effects on Standard of living of people, but if we do not consider social side effects, it may create some problems. This can be justified through the inverted -U Kuznets (1955). According to this theory, income inequality is high in the early stages of economic growth and on the other hand, many studies the effectiveness of inequality of income distribution on crime has been proven⁶. It shows us that we should consider distribution of income as we pay attention to growth of it.

The policy implications derived from this study indicate that EU needs to take more consideration about joining new members of the union. It is evident that crime affects negatively on economic growth and most of new applicants of accession to the union are from countries that have higher crime rates than average of crime in the EU. Most of the countries are from East Europe that has high average crime⁷ and this can threaten economic growth in the EU. As the EU is facing European migrant crisis that can create new social and security problems for this region.

Concluding Remarks

We study the relationship between crime and economic growth in 27 member countries of the EU in the period of 2004-2014. In order to have more efficient estimates we improve estimation by using “GMM-SYS”

⁶ Becker(1968), Messner(1982), Hsieh and Pugh (1993),; Lederman et al. (2002),66. Fajnzylber, Lederman, and Loayza, N. (2002), Demombynes and Özler,(2005)

⁷ For example, Turkey has an average of 4.5 murders per 100,000 people, in the period of 2003-2012.

model and choosing optimal lag for variables. On the process of study we face some limitations such as lack of information about crime in European Cyprus and United Kingdom's withdrawal from the EU (Brexit). Then we have to relieve Cyprus from our calculations but because Brexit has not done completely we consider Britain as a EU member.

To verify this relationship by using Panel Var model it has been concluded that there is a bidirectional causal relation between economic growth and crime as we have seen in many studies we have referred in section 1. The occurrence of a shock on crime reduces economic growth; in many previous studies, similar results have been obtained⁸.

Crime in the early stages of occurrence has a more negative impact on economic growth, but over time its impact on growth is reduced. The results are visible in the impulse response functions and variance analysis.

The occurrence of a shock to economic growth causes the growth of crime in the early stages of shock. Therefore it can be concluded that the occurrence of a shock in economic growth raise the inequality and then the crime. However, over several periods and reduction of inequality impacts, economic growth reduces crime and causes it to reach to a level lower than the initial level (Diagram 2).

Crime also has a significant and negative effect on investment as a factor of economic growth; this can be because of the reduction of security in a society which prevents investors from more investing. As what is explained in section 1, crime can affect negatively on social capital and then economic growth. Higher expenditure on education results in an improvement in economic growth because of human capital development. As a result, crime reduces investments, population growth and economic growth in country members of the European Union.

⁸ Cárdenas, 2007; Gaibullov et al., 2008

References

- Abrigo, M. R., & Love, I. (2015). Estimation of panel vector autoregression in Stata: A package of programs. manuscript, Febr 2015 available on <http://paneldataconference2015.ceu.hu/Program/Michael-Abrigo.pdf>.
- Aghion, P., Boustan, L., Hoxby, C., & Vandebussche, J. (2009). The causal impact of education on economic growth: evidence from US. Unpublished paper.
- Ahn, S. C., & Schmidt, P. (1995). Efficient estimation of models for dynamic panel data. *Journal of econometrics*, 68(1), 5-27.
- Anderson, D. A. (1999). The aggregate burden of crime*. *The Journal of Law and Economics*, 42(2), 611-642.
- Andersson, B., (2001) Scandinavian Evidence on Growth and Age Structure, *Regional Studies*, Vol.35, no.5
- Andrews, D. W., & Lu, B. (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models. *Journal of Econometrics*, 101(1), 123-164.
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, 58(2), 277-297.
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1), 29-51.
- Barro, R. J. (2001). Human capital and growth. *The American Economic Review*, 91(2), 12-17.
- Becker, G. S. (1968). Crime and punishment: An economic approach. In *The Economic Dimensions of Crime* (pp. 13-68). Palgrave Macmillan UK.

- BenYishay, A., & Pearlman, S. (2014). Crime and microenterprise growth: Evidence from Mexico. *World Development*, 56, 139-152.
- Binder, M., Hsiao, C., & Pesaran, M. H. (2005). Estimation and inference in short panel vector autoregressions with unit roots and cointegration. *Econometric Theory*, 21(04), 795-837.
- Bjørnskov, C. (2012). How does social trust affect economic growth?. *Southern Economic Journal*, 78(4), 1346-1368.
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87(1), 115-143.
- Bond, S. R. (2002). Dynamic panel data models: a guide to micro data methods and practice. *Portuguese economic journal*, 1(2), 141-162.
- Brand, S., & Price, R. (2000). *The economic and social costs of crime*. London: Home Office.
- Burnham, R., Feinberg, R. M., & Husted, T. A. (2004). Central city crime and suburban economic growth. *Applied Economics*, 36(9), 917-922.
- Canova, F., & Ciccarelli, M. (2013). Panel Vector Autoregressive Models: A Survey☆☆ The views expressed in this article are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem. *VAR Models in Macroeconomics–New Developments and Applications: Essays in Honor of Christopher A. Sims (Advances in Econometrics, Volume 32)* Emerald Group Publishing Limited, 32, 205-246.
- Cárdenas, M., & Rozo, S. (2008). Does Crime Lower Growth?: Evidence from Colombia. *International Bank for Reconstruction and Development/The World Bank*.
- Cass, D. (1965). Optimum growth in an aggregative model of capital accumulation. *The Review of economic studies*, 32(3), 233-240.

- Chatterjee, I., & Ray, R. (2009). Crime, corruption and institutions. Monash University, Department of Economics Discussion Paper, 20(09).
- Coleman, J. S. (1988). Social capital in the creation of human capital. *American journal of sociology*, S95-S120.
- Czabanski, J. (2008). Estimates of cost of crime: history, methodologies, and implications. Springer Science & Business Media.
- Demombynes, Gabriel, and Berk Özler. "Crime and local inequality in South Africa." *Journal of Development Economics* 76, no. 2 (2005): 265-292.
- Detotto, C., & Otranto, E. (2010). Does crime affect economic growth?. *Kyklos*, 63(3), 330-345.
- Detotto, C., & Pulina, M. (2013). Does more crime mean fewer jobs and less economic growth?. *European Journal of Law and Economics*, 36(1), 183-207.
- Detotto, C., & Vannini, M. (2010). Counting the cost of crime in Italy. *Global Crime*, 11(4), 421-435.
- Fajnzylber, P., Lederman, D., & Loayza, N. (2002). What causes violent crime?. *European Economic Review*, 46(7), 1323-1357.
- Forni, M., & Paba, S. (2000). The sources of local growth: evidence from Italy. *Giornale degli economisti e annali di economia*, 1-48.
- Gaibulloev, K., & Sandler, T. (2008). Growth consequences of terrorism in Western Europe. *Kyklos*, 61(3), 411-424.
- Gaviria, A. (2002). Assessing the effects of corruption and crime on firm performance: evidence from Latin America. *Emerging Markets Review*, 3(3), 245-268.
- Geis, G., & Jesilow, P. (1982). On white-collar crime (p. 53). LexingtonBooks.
- Goulas, E., & Zervoyianni, A. (2012). Growth, Deficits and Uncertainty in a Panel of 28 Countries (No. 52_12).

Goulas, E., & Zervoyianni, A. (2012). Growth, Deficits and Uncertainty in a Panel of 28 Countries (No. 52_12).

Goulas, E., & Zervoyianni, A. (2015). Economic growth and crime: Is there an asymmetric relationship?. *Economic Modelling*, 49, 286-295.

Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica: Journal of the Econometric Society*, 1371-1395.

Hsieh, C. C., & Pugh, M. D. (1993). Poverty, income inequality, and violent crime: a meta-analysis of recent aggregate data studies. *Criminal Justice Review*, 18(2), 182-202.

Huang, B. N., Hwang, M. J., & Yang, C. W. (2008). Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach. *Ecological economics*, 67(1), 41-54.

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of econometrics*, 90(1), 1-44.

Kuznets, S. (1955). Economic growth and income inequality. *The American economic review*, 45(1), 1-28.

Lambsdorff, J. G. (2003). How corruption affects persistent capital flows. *Economics of Governance*, 4(3), 229-243.

Lean, H. H., & Smyth, R. (2010). CO 2 emissions, electricity consumption and output in ASEAN. *Applied Energy*, 87(6), 1858-1864.

Lederman, D., Loayza, N., & Menendez, A. M. (2002). Violent crime: does social capital matter?. *Economic Development and Cultural Change*, 50(3), 509-539.

Lochner, L., & Moretti, E. (2004). The effect of education on crime: Evidence from prison inmates, arrests, and self-reports. *The American Economic Review*, 94(1), 155-189.

Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance*, 46(2), 190-210.

Machin, S., Marie, O., & Vujić, S. (2011). The crime reducing effect of education. *The Economic Journal*, 121(552), 463-484.

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and statistics*, 61(S1), 631-652.

Malthus, Thomas, (1798). *An Essay on the Principle of Population*. Prometheus Books, Amherst, NY, Reprint 1998.

Mantzavinos, C., North, D. C., & Shariq, S. (2004). Learning, institutions, and economic performance. *Perspectives on politics*, 2(01), 75-84.

Mauro, L., & Carmeci, G. (2007). A poverty trap of crime and unemployment. *Review of Development Economics*, 11(3), 450-462.

Mauro, L., & Carmeci, G. (2007). A poverty trap of crime and unemployment. *Review of Development Economics*, 11(3), 450-462.

Mauro, P. (1995). Corruption and growth. *The quarterly journal of economics*, 681-712.

Meghir, C., Palme, M., & Schnabel, M. (2012). The effect of education policy on crime: an intergenerational perspective (No. w18145). National Bureau of Economic Research. Messner, S. F. (1982). Poverty, inequality, and the urban homicide rate: Some unexpected findings. *Criminology*, 20(1), 103-114.

Neanidis, K. C., & Papadopoulou, V. (2013). Crime, fertility, and economic growth: Theory and evidence. *Journal of Economic Behavior & Organization*, 91, 101-121.

- Neyman, J., & Scott, E. L. (1948). Consistent estimates based on partially consistent observations. *Econometrica: Journal of the Econometric Society*, 1-32.
- Ojog, D (2014). The effect of crime on economic growth(Bachelor thesis, Erasmus School of Economics, Rotterdam, Netherland)
- Papagapitos, A., & Riley, R. (2009). Social trust and human capital formation. *Economics Letters*, 102(3), 158-160.
- Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and statistics*, 61(s 1), 653-670.
- Pedroni, P. (2004). Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory*, 20(03), 597-625.
- Peri, G. (2004). Socio-cultural variables and economic success: evidence from Italian provinces 1951-1991. *Berkeley Electronic Journal, Topics in Macroeconomics*, 4(1), 12.
- Putnam, R. (2001). Social capital: Measurement and consequences. *Canadian Journal of Policy Research*, 2(1), 41-51.
- Rincke, J. (2015). The Effect of Crime on Regional Economic Performance: Evidence from US Metropolitan Areas.
- Rosenfeld, R., Baumer, E. P., & Messner, S. F. (2001). Social capital and homicide. *Social Forces*, 80(1), 283-310.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, 65-94.
- Swan, T. W. (1956). Economic growth and capital accumulation. *Economic record*, 32(2), 334-361.
- Wang, S. S., Zhou, D. Q., Zhou, P., & Wang, Q. W. (2011). CO₂ emissions, energy consumption and economic growth in China: a panel data analysis. *Energy Policy*, 39(9), 4870-4875.