Selçuk Ün. Sos. Bil. Ens. Der. 2019; (Prof. Dr. Fuat Sezgin Özel Sayısı): 25-33
- İktisat / Araştırma -

The Impact of GDP Per Capita and Crime Rate on the $C0_2$ Emission

Deniz GÜVERCİN*

ABSTRACT

The study aims to examine empirically the impact of GDP per capita as well as the crime rate on carbon emission. Because these variables are endogenously determined we use Panel VAR methodology. The study contributes to the literature by examining the nexus among the carbon emission, the crime rate and the GDP per capita. For the purpose of the study, we use data for 21 European countries over the period 1996-2014. Panel Granger causality tests indicate that there is a bi-directional causality between GDP per capita and homicide. Panel granger causality tests also indicate that there is a unidirectional causality from carbon emission to GDP, and from carbon emission to homicide rates. Moreover, according to forecast error variance decomposition results carbon emission explains 40 % of the variance of the GDP per capita. GDP per capita explains 60% of the variance of the GDP per capita. Additionally, a high portion of variances of homicide rate and carbon emission is explained by changes in these variables. According to impulse response functions; homicide rate decreases and carbon emission does not change if there is a one time, one standard deviation shock to GDP per capita. Impulse response function results indicate that GDP per capita decreases and carbon emission does not change if there is a one time, one standard deviation shock to homicide rates. Moreover, impulse response function results show that GDP per capita increases and homicide rate increases if there is a one time, one standard deviation shock to carbon emission. These results imply that GDP per capita increase would impact crime negatively along the development path through direct and indirect channels. Even though the findings showing that GDP per capita does not affect carbon emission conflict with some of the studies in the literature, the positive impact of carbon emission on the economic wellbeing can be explained by the view granted by the Pollution Haven Hypothesis.

Keywords: Carbon Emission, GDP Per Capita, Homicide Rates, Environmental Degradation, Panel VAR.

Kişi Başı Gayri Safi Yurtiçi Hasıla ve Suç Oranının Karbon Salınımı Üzerine Etkisi

ÖZ

Çalışma, kişi başı Gayrisafi Yurtiçi Hasıla, suç oranının karbon salınımı üzerine etkisini incelemektedir. Çalışma, suç ve kişi başı Gayrisafi Yurtiçi Hasıla'nın etkileştiği ve karbon salınımı üzerine doğrudan ve dolaylı olarak etkilerde bulunduğu üzerine teorik olarak kurgulanmıştır. Bu çalışma ilgili literatüre, karbon salınımı, kişi başı Gayrisafi Yurtiçi Hasıla ve cinayet oranları arasındaki ilişkiyi inceleyerek ve bunu yapan ilk çalışma olması nedeniyle katkıda bulunmaktadır. Çalışma, 1996-2014 periyodu için 21 Avrupa Birliği ülkesi verisini kullanmaktadır. Değişkenler arasındaki etkileşimi ve içsel belirlenmeyi dikkate alan Panel VAR ekonometri yöntemi kullanılmıştır. Panel Granger nedensellik sonuçları kişi başı Gayrisafi Yurtiçi Hasıla ve cinayet oranları arasında iki yönlü nedensellik ve karbon salınımından, kişi başı Gayrisafi Yurtiçi Hasıla'ya tek yönlü nedenselliğin olduğunu göstermektedir. Varyans ayrıştırma sonuçlarına göre karbon salınımı, kişi başı Gayrisafi Yurtiçi serisindeki değişimin %40'lık kısmını açıklamaktadır, kişi başı Gayrisafi Yurtiçi Hasıla ise kendinde olan değişimin %60'lık kısmını açıklamaktadır. Bunlara ilaveten, cinayet oranı ve karbon salınımı değişkenleri ise kendilerindeki değişimi en yüksek yüzdeyle açıklamaktadırlar. Etki-tepki analizi sonuçları; kişi başına Gayrisafi Yurtiçi Hasıla'ya bir kerelik, bir standart hatalık şok gelmesi durumunda , cinayet oranının azaldığını , karbon salınımının da aynı şokla karşı karşıya olduğunda değişmediğini göstermektedir. Etki tepki sonuçları; cinayet oranına bir kerelik, bir standart hatalık şok gelmesi durumunda kişi başı Gayrisafi Yurtiçi Hasılanın azaldığını , karbon salınımının ise aynı şokla karşı karşıya olduğunda değişmediğini göstermektedir. Bunlara ilaveten, etki tepki analizi sonuçları; karbon salınımına bir kerelik, bir standart hatalık şok gelmesi durumunda kişi başı Gayri Safi Yurtiçi Hasılanın arttığını ve cinayet oranının da aynı şokla karşı karşıya olduğunda arttığını göstermektedir. Araştırma bulguları; kişi başı Gayri Safi Yurtiçi Hasılanın, cinayet oranını ekonominin kalkınma patikası boyunca dolaylı ve dolaysız kanallar aracılığıyla negatif etkilediğini göstermektedir. Her ne kadar kişi başı Gayri Safi Yurtiçi Hasılanın karbon salınımını etkilemediği ilgili literatürdeki bazı çalışmalarla çelişse de, karbon salınımının kişi başı Gayri Safi Yurtiçi Hasılayı arttırdığı Kirlilik Sığınağı hipotezi çerçevesinde ele alınabilir.

Anahtar Kelimeler: Karbon Salınımı, Kişi Başı Gayrisafi Yurtiçi Hasıla, Cinayet Oranı, Çevresel Yıkım, Panel VAR.

1. Introduction

Carbon dioxide (CO_2) emissions from the burning of fossil fuels are the main cause of global warming (IPCC 2014). The statistics about the carbon emission level show that the carbon emissions expanded by the factor of three in the 2000s compared to the 1990s (de Vries and Ferrarini, 2017; 213-215). Economic processes including production, consumption of goods and services or extraction of raw materials result

* Dr. Öğr. Üyesi, İstanbul Arel Üniversitesi, orcid no: 0000-0001-6158-3877, denizguvercin@arel.edu.tr
Makalenin Gönderim Tarihi: 03.12.2018; Makalenin Kabul Tarihi: 24.12.2019

in environmental degradation so that there should be certain control measures to prevent excessive usage of fossil fuels.

As criminals/offenders would be discounting highly the future consumption levels (Dilulio, 1996; 6-12) including the consumption of environmental goods, the regions with a high crime rate might face severe environmental degradation. The environmental consequences of criminal activity might be significant even they are not very apparent likewise its economic or moral consequences. Crime rate and the level of economic activity at the local level are related since participating in crime increases with a reduction in the opportunity cost of crime measured by the income loss if arrested. On the other hand, crime activity would affect economic activity by affecting the level of investment in the region.

There are several empirical studies in the relevant literature implementing causal inference methods showed that police forces negatively impact the crime rate (Lin, 2009; Chalfin and McCrary; 2018). On the other hand, countries using police forces and other crime prevention system to deter crime exhaust important portion of the government budget affecting the public funding for environmental preservation. Therefore, public funds directed to the high crime rate locations would affect indirectly the environmental preservation in the country.

Because economic activity and living conditions are under permanent threat of criminal activities and the quality of life is already low from many dimensions in locations with high crime rates, people, or firms more likely to underinvest in green technologies leading to environmental degradation. Additionally, residents would not be willing to invest in high pollution abatement costs as there would not be a social convention on the clean environment in places with a high crime rate.

There are few studies in the literature on the nexus between crime and pollution. Skudder et al., (2017; 365-367), Pease (2009; 12-15) argue that the carbon cost of crime arises because the replacement of damaged property requires reproduction. Moreover, offices of the criminal justice system (police, legal defense, and probation, prison and jury services) would run overtime in the case of rising crime rate resulting in high carbon emission (Skudder et al., 2017; 357)[*].

Becker (1968; 180-200) analyzes crime participation behavior by economic incentives as well as disincentives imposed by criminal justice. According to Becker's (1968)'s approach, an individual would commit a crime if the expected payoff from committing the crime is greater than its expected cost. It can be argued that the expected benefit of committing property crime for the individual suffering from low income would be high since the marginal utility of an additional dollar would be very high. Moreover, for personal crimes such as homicide, the individual would become more likely to commit the crime if the opportunity cost of committing a crime is low that would be relevant to arrest rate or the severity of punishment. Moreover, the opportunity cost of crime increases with economic return markets provide in exchange for its skills, or endowments.

There are several studies on the nexus between economic growth and carbon emission level. Since the seminal work of Grossman and Krueger (1993; 1995) several empirical researches have been undertaken to investigate the inverted-U shaped relation between economic growth and carbon emission called as Environmental Kuznets Curve (EKC). Namely, these studies (Selden and Song, 1994; Bimonte et al., 2001; Shahbaz et al., 2013) show that carbon emission increases with GDP per capita till certain threshold. EKC implies that laws and regulations on environment is endogenous to the GDP per capita. In other words, society would demand clean environment, which is normal good, as they obtain higher GDP per capita. Therefore, the EKC implies that rigidity of environmental laws (such as water pollution control, land pollution policy or solid waste disposal policy) is correlated with economic development (Panayotou, 2016; 140-148).

On the other hand, there are also studies in the relevant literature which show that the there is a positive impact of economic growth on carbon emission while it is not concave as argued by EKC (Holtz-Eakin and Selden, 1995; Azam, 2016). Moreover, there are also studies in the relevant literature showing

[*] Skudder et al., (2017) argue that the greenhouse gas emission cost of crimes differs across crime types. For example; personal crimes including homicide, wounding and sexual offenses have low total carbon emission costs since few goods are there to be replaced.

that economic growth does not have any impact on the carbon emission (Agras and Chapman, 1999; Richmond and Kaufmann, 2006).

Carbon emission might affect the GDP per capita in various ways. Carbon emission by affecting water/air quality (Jacobson, 2008; 1-5) would negatively affect the market value of agricultural (final) goods, or leads to a decrease in the quality of raw materials, agricultural inputs. Additionally, an increase in carbon emission worsens people's health conditions (Watson et al., 2005; 836-838) leading to a decline in workers' productivity and a decrease in GDP per capita.

Carbon emission might affect crime in various ways. An increase in carbon emission would decrease the quality of life, such as a reduction in water/air quality which would affect the opportunity cost of committing a crime. Moreover, it can be argued that as individual decides every day on whether to consume/produce less carbon emission-intensive goods and services, he basically decides about morality, in the environmental sense, of his economic behavior which would not very irrelevant to likelihood to undertake criminal activity such as the fraud or the property crime. Additionally, Kuo and Sullivian (2001; 345-350) argue that a clean environment affects positively the mood and attitudes contributing to the societal interactions in the neighbor that would negatively impact domestic violence.

Moreover, GDP per capita might affect indirectly the crime rate through its impact on environmental degradation. Since GDP per capita would decrease the environmental degradation as emphasized by the EKC (Selden and Song, 1994; Bimonte et al., 2001; Shahbaz, 2013), it would decrease the opportunity cost, and incentive to commit a crime. On the other hand, economic stagnation by increasing the crime rate (Mehlum et al., 2005; 329-332) might lead to environmental degradation.

Additionally, an increase in GDP per capita would contribute to the public resources devoted for human capital accumulation which would decrease the future crime rate due to an increase in the opportunity cost of committing a crime (high wage rate) as well as an increase in awareness of social and moral consequences of committing a crime. An increase in education also decreases the crime rate against the environment as the individual becomes more integrated into social life and is provided more opportunities to derive higher life quality complementing with clean environment. GDP per capita increase would also provide more resources to be used for crime prevention such as an increase in police forces, and an increase in wage level for police forces motivating high arrest rate and intensive monitoring over crime areas. Moreover, technological capacity in crime prevention that contains the high technology security systems monitoring crime intensive areas would advance with GDP per capita.

Endogenous determination of variables of environmental degradation, crime rate and GDP per capita can also be emphasized through income inequality. Suppose that the economy for poor countries grows where there are plenty of people living below the poverty line and the crime rate is high due to the low opportunity cost of committing a crime. As the economy grows there would be people moving from lower-income class to higher income class that would possibly decrease the crime rate. If markets do not deliver economic returns equally among members of society, people might use the crime market to complement their legal earnings or become alienated from society and commits a crime (Kelly, 2000; 535-537). Therefore, if the income inequality persists along the development path, even the number of people below the poverty line decreases, the environmental degradation, as well as the crime rate, might stay at a certain level.

The environmental degradation particularly due to production and consumption activities (at the climbing side of the EKC) might result in certain irrevocable natural consequences such as soil erosion, , global warming or water pollution. For example, it is argued that the consequences of Hurricane Katrina were magnified by the unwise coastal development and activities of oil and gas drilling (Brisman, 2007; 728-730). Therefore, environmental degradation might result in great loss in human and physical capital and in natural resources in irrevocable ways that would generate a great loss in future GDP levels.

The study aims to examine empirically the impact of GDP per capita as well as the crime rate on carbon emission. Because these variables interact and are endogenously determined we evaluate the direct and indirect effects of these variables on the carbon emission by using Panel VAR methodology that deals with endogeneity. The study uses data for 21 European countries for the period of 1996-2014.

The paper is one of the few empirical studies exploring the nexus between carbon emission and crime rate. Additionally, the paper contributes to the literature by being the first empirical investigation on the nexus between environmental degradation, crime and economic outcome nexus. The paper is structured as follows. The second section discusses data and methods which is followed by the section on the empirical results. The conclusion section wraps up the findings of the paper.

2. Material and Methods

This study uses data for 21 European countries for the period of 1996-2014. The countries are; Australia, Austria, Denmark, Crotia, Czech Republic, Finland, France, Greece, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Romania, Slovenia, Slovak Republic, Spain, Switzerland, Sweden, United Kingdom. The sample period and the countries in Europe are selected according to data availability. Table 1 illustrates the variables used and the sources for these variables.

Table 1. Variables and Source

Variable	Source
Carbon Emission (in Logarithm) (CO2, Metric tons per capita)	World Development Indicators
GDP per capita (in Logarithm) (GDPPC, Constant $)	World Development Indicators
Intentional Homicides (in Logarithm) (per 100,000 people)	World Development Indicators

Table 2 displays the descriptive statistics for the variables.

Table 2. Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Minimum	Maximum
D.CO2*	378	-.015	.054	-.21	.19
GDPPC	399	10.24	.654	8.47	11.2
HOMICIDE	399	.24	.44	-2.3	1.58

Source: Author's Own Calculation.

The following table illustrates the unit root tests for these variables. Because the empirical model is Panel VAR, we check the stability of the system by checking whether these variables are stationary or not by unit root tests. We used the Levin-Lin-Chu unit root test for the purpose.

Table 3. Unit Root Test Result

Variable	**Statistic**	**P-value**	**Order of Integration**
CO2	-10.83	.006	I(1)
GDPPC	-8.24	.000	I(0)
HOMICIDE	-14.53	.000	I(0)

Source: Author's Own Calculation.

Unit root tests indicate that GDPPC, HOMICIDE variables are stationary at levels, whereas CO2 is stationary at the first difference level. Therefore, we used GPDPPC and HOMICIDE at level and CO2 at first difference to apply the Panel VAR model.

Table 4. Optimal Lag Selection Criteria*

LAG	CD	J	J p-value	MBIC	MAIC	MQIC
1	.99	47.4	.008	-104.02	-6.56	-45.68
2	.99	36.1	.006	-64.85	.12	-25.96
3	.99	26.1	.001	-23.7	8.7	-4.32

Source: Author's Own Calculation.

$$x_{it} = \mu_i + Z(l)\, X_{it-1} + e_{it} \qquad (1)$$

$i = 1, \ldots 21$; $t = 1, \ldots, 19$;

* D.CO2 represents the differenced form of CO2 variable.

* MBIC: Value of modified BIC; MAIC: Value of modified AIC; MQIC: Value of modified HQ; J: Value of Hansen's J statistics.

x is dependent variable; X is a vector of (lagged) regressors; Z is the vector of coefficients including own and cross-effects of the *l*th lag of the regressors (including the dependent variable). Because the country-specific effects are correlated with an error term, and variables dynamically interrelated, as discussed in the introduction section, estimating the model through OLS would lead to biased coefficients. The model is transformed to remove the unobserved individual effects by forward orthogonal deviation (Arellano and Bover, 1995; 30-32) and estimated with GMM method using lagged observations as instruments (Amorim and Alves de Silva, 2016; 4). The model results displayed in table 6. The model estimations are performed at Stata by using the codes provided by Abrigo & Love (2016; 8-28).

The optimal lag criteria which are displayed at table 4 indicate that optimal lag for the analysis is 1. Table 5 shows the Panel Granger Causality test results.

3. Results

Granger causality test results displayed in Table 5 below indicate that carbon emission and the homicide granger cause GDP per capita. Moreover, carbon emission and GDP per capita granger cause homicide variable. However, neither GDP per capita nor homicide granger cause the carbon emission. The ordering of the variables in the VAR model should be made according to the endogeneity of the variables in the sense that the most exogenous of the variable is ordered before other variables. The granger causality test results is used for the determination of the ordering of the variables.

Table 5. Panel VAR Granger Causality Test Results

Equation/Excluded	D.CO2	GDPPC	HOMICIDE	ALL
D.CO2		.209 (.647)	.694 (.405)	.746 (.689)
GDPPC	20.475 (.000)		3.244 (.072)	22.422 (.000)
HOMICIDE	7.926 (.005)	42.866 (.000)		57.377 (.000)

Source: Author's own calculation.

Note : The Chi-Square values are in the cells and the probability values are in the parenthesis. The bold characters represent the presence of Granger causality from the excluded variable in the column to the equation variable in the row. The bold characters show the presence of Granger causality.

Forecast error variance decomposition which is sensitive to the ordering of the variables is displayed below at Table 6. The decomposition measures the forecast error variance of an endogenous variable that can be attributed to orthogonalized shocks to itself or to another endogenous variable.

Table 6. Forecast Error Variance Decomposition

Response Variable	**Forecast Horizon**	**Impulse Variable**		
		D.CO2	**HOMICIDE**	**GDPPC**
D.CO2	3	.98	.015	.000129
	7	.98	.016	.000269
	10	.98	.016	.00039
HOMICIDE	3	.066	.90	.026
	7	.077	.85	.065
	10	.09	.83	.08
GDPPC	3	.31	.004	.68
	7	.40	.0026	.60
	10	.41	.0021	.58

Source: Author's own calculation.

According to results displayed in Table 6 indicates that carbon emission has great explanation power (40 %) in explaining the variance of the GDPPC whereas the greatest explanation power in explaining the variance of GDPPC is itself. On the other hand, the greatest portion of variances of Homicide and Carbon emission are explained by themselves.

Table 7. Panel VAR Estimates

	Coefficient	Standard Errors	t-Value	P-Value	95% Confidence Interval
D.CO2(t)					
D.CO2(t-1)	.38	.15	.52	012	.085 - .68
GDPPC(t-1)	.028	.062	0.46	.647	-.095 - .15
HOMICIDE(t-1)	.026	.031	0.83	.405	-.035 -.087
HOMICIDE (t)					
D.CO2(t-1)	1.35	.48	2.82	.005	.41 - 2.3
HOMICIDE(t-1)	.168	.08	2.16	.031	.015 - .32
GDPPC(t-1)	-1.29	.19	-6.55	.000	-1.67 - -.90
GDPPC(t)					
D.CO2 (t-1)	.157	.035	4.52	.000	.09- .225
HOMICIDE(t-1)	-.012	.007	-1.8	.072	-.026 - .001
GDPPC(t-1)	.9	.018	9.34	000	.86 - .94
Number of Observation			336		
Number of Panels			21		
Average Number of T			16		
Final GMM Criterion Q(b)			.182		
Instruments			L(1/4) (D.CO2 HOMICIDE GDPPC)		

Source: Author's own calculation

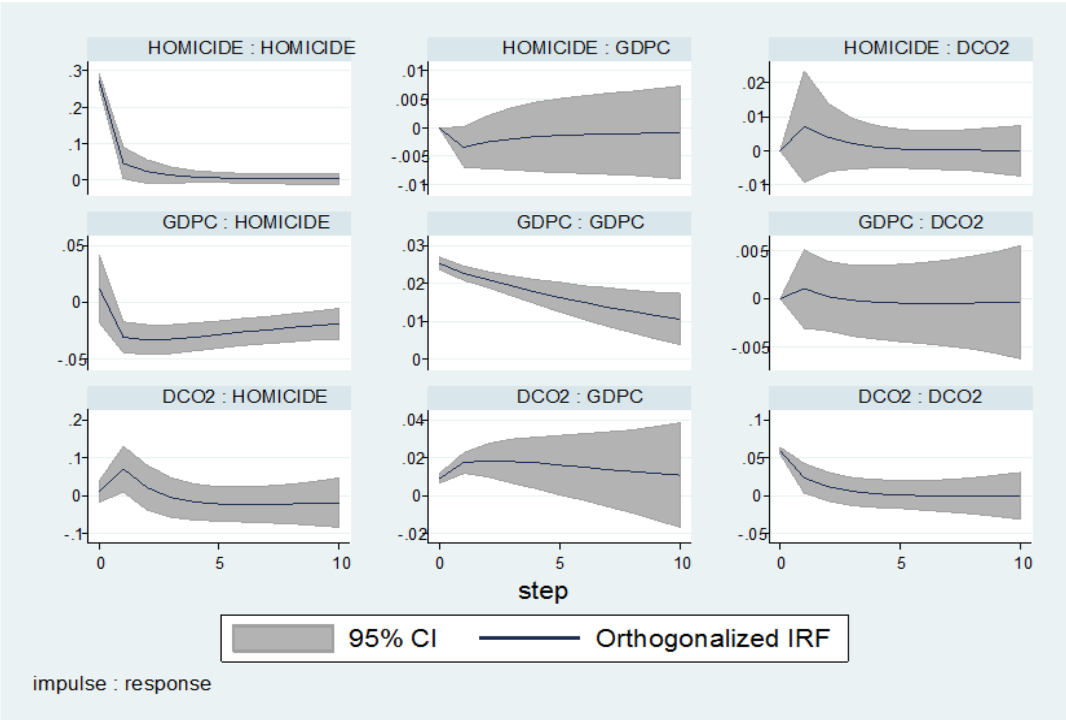

Figure 1. Impulse Response Functions
Source: Author's own calculation

Impulse response functions suggest that response of homicide rate to a one time, one standard deviation in GDP per capita is negative significant and the response of carbon emission to one standard deviation in GDP per capita is not significant. This result suggests that GDP per capita does not impact the carbon emission. The result also indicates that the homicide rate decreases with GDP per capita confirming that increasing opportunity cost of crime rising with income that contributes to the decreasing crime rate.

The response of GDP per capita to a one-time, one standard deviation innovation in homicide rate is negative significant and the response of carbon emission to one standard deviation in homicide rate is not significant In other words, declining crime contributes GDP per capita while it does not impact carbon emission. Additionally, the response of GDP per capita to a one time one standard deviation innovation in carbon emission is positively significant and the response of homicide rate to one standard deviation in carbon emission is positively significant. In another words, carbon emission increases crime and GDP per capita.

The results indicate the statistically weak linkage from the environmental degradation to income loss due to air pollution, a decrease in water quality or worsening health conditions and decreased productivity. Contrarily, the result would suggest the positive impact of low cost carbon-intensive production on GDP per capita.

It can be argued that if the number of pollutant firms is high because environmental laws/regulations are not rigid there would be more attempt to produce carbon-intensive goods because the probability of being caught would be small that would result in market expansion and higher GDP per capita level particularly for countries suffering from chronic demand deficiencies. Additionally, according to Pollution Haven Hypothesis (Cole, 2004; Levinson and Taylor, 2008), countries with high carbon emission would be attracted to firms located in countries with a clean environment whose cost of production is high due to pollution abatement costs. Therefore, pollution might bring economic growth before the long-run implications of carbon emission hit economic resources. On the other hand, carbon emission increases homicide would indicate that major role of environmental assets (air quality, green spaces, etc.) in determining life quality, psycho-social conditions and motivation (mood) to participate in the crime.

Due to dynamic interdependency among variables, we can argue that economic policies increasing GDP per capita would decrease crime while a decrease in crime would contribute to an increase in GDP per capita. Moreover, policies targeting low carbon emission would negatively contribute to GDP per capita and crime rate while a decrease in GDP per capita worsen economic welfare, a decrease in crime would contribute to the economic welfare.

4. Conclusion

The study aims to examine empirically the impact of GDP per capita as well as the crime rate on carbon emission. The Panel VAR methodology is used to account for the dynamic interdependency among variables. The study contributes to the literature by examining the nexus between the carbon emission, the crime rate and the GDP per capita. For the purpose of the study, we use data for 21 European countries over the period 1996-2014.

Because crime rate and GDP per capita are stationary at levels they enter into the model in the level form, however, the carbon emission is not stationary at level, thus, it enters into the model in the first difference form. Panel Granger causality test results indicate that carbon emission and the homicide rate granger cause GDP per capita. Moreover, carbon emission and GDP per capita granger cause homicide rates. However, neither GDP per capita nor homicide granger cause the carbon emission.

Moreover, according to forecast error variance decomposition results in carbon emission explain 40 % of the variance of the GDP per capita explains 60 % of the variance of the GDP per capita. Moreover, the greatest portion of variances of homicide rate and carbon emission is explained by themselves.

Impulse response functions suggest that response of homicide rate to a one time, one standard deviation in GDP per capita is negative significant and the response of carbon emission to one standard deviation in GDP per capita is not significant. This result suggests that GDP per capita does not impact the carbon emission. The result also indicates that the homicide rate decreases with GDP per capita confirming that increasing opportunity cost of crime rising with income contributes to the decreasing crime rate.

The response of GDP per capita to a one-time, one standard deviation innovation in homicide rate is negative significant and the response of carbon emission to one standard deviation in homicide rate is not significant In other words, declining crime contributes GDP per capita while it does not impact carbon emission. Additionally, the response of GDP per capita to a one time one standard deviation innovation

in carbon emission is positively significant and the response of homicide rate to one standard deviation in carbon emission is positively significant. In other word, carbon emission increases crime and GDP per capita.

Public policies aiming to reduce carbon emission would affect GDP and homicide levels in different directions. The model implies that if public policies punishing the carbon-intensive energy used in production are put in action, both crime rate and the GDP per capita would decline. Decreasing homicide rates would generate a positive effect on GDP whereas a decrease in GDP would induce a positive impact on the homicide rate. In the absence of linkage from GDP per capita and homicide rate to carbon emission, policies increasing GDP per capita would decrease homicide rate which would positively impact GDP per capita along the development path.

References

Abrigo, M. R. M. & Love, I. (2015). Estimation of panel vector autoregression in Stata: A package of programs. Manuscript, Febr 2015 [Online] Available at: <http://paneldataconference2015. ceu. hu/Program/Michael-Abrigo. pdf>, [Erişim tarihi: 08.10.2018].

Agras, J. and Chapman, D. (1999). *"A Dynamic Approach to the Environmental Kuznets Curve Hypothesis"*, Ecological Economics, 28 (2): 267-277.

Amorim, G. and Da Silva, M. E. A. (2016). Governance and Growth: A Panel VAR Approach. [Online] Available at: <https://www.anpec.org.br/encontro/2016/submissao/files_I/i6-b664b335dcf00c41e5f5adbbd539cbd1.pdf>, [Erişim tarihi: 06.10.2018].

Arellano, M. and Bover, O. (1995). "*Another Look at the Instrumental Variable Estimation of Error-components Models*", Journal of Econometrics, 68 (1): 29-51.

Azam, M. (2016). "*Does Environmental Degradation Shackle Economic Growth? A Panel Data Investigation on 11 Asian Countries*", Renewable and Sustainable Energy Reviews, no: 65, p. 175-182.

Becker, G. S. (1968). "*Crime and Punishment: An Economic Approach*", Journal of Political Economy, 76 (2): 168-217

Bimonte, S. (2001). "*Model of Growth and Environmental Quality. A New Evidence of the Environmental Kuznets Curve*". Universita degli Studi di Siena Quaderni, no: 321, p. 1-26.

Brisman, A. (2007). "*Crime-environment Relationships and Environmental Justice*", Seattle Journal for Social Justice, 6 (2): 727-817

Chalfin, A. and McCrary, J. (2018). "*Are US Cities Underpoliced? Theory and Evidence*", Review of Economics and Statistics, 100 (1): 167-186.

Cole, M. A. (2004). "*Trade, the Pollution Haven Hypothesis and the Environmental Kuznets Curve: Examining the Linkages*", Ecological Economics, 48 (1): 71-81.

de Vries, G. J., and Ferrarini, B. (2017). "*What Accounts for the Growth of Carbon Dioxide Emissions in Advanced and Emerging Economies? The Role of Consumption, Technology and Global Supply Chain Participation*", Ecological Economics, no: 132, p. 213-223.

DiIulio, J. J. (1996). "*Help Wanted: Economists, Crime and Public Policy*", Journal of Economic Perspectives, 10 (1): 3-24.

Grossman, G. M., & Krueger, A. B. (1993). Environmental Impacts of a North American Free Trade Agreement, Garber P.(éd.), The US-Mexico Free Trade Agreement, MIT Press, Cambridge, MA, 1655177.

Grossman, G. M. and Krueger, A. B. (1995). "*Economic Growth and the Environment*", The Quarterly Journal of Economics, 110 (2): 353-377.

Holtz-Eakin, D. and Selden, T. M. (1995). "*Stoking the Fires? CO2 Emissions and Economic Growth*", Journal of Public Economics, 57 (1): 85-101.

Jacobson, M. Z. (2008). "*On the Causal Link between Carbon Dioxide and Air pollution Mortality*", Geophysical Research Letters, 35 (3): 1-45.

Kelly, M. (2000). "*Inequality and Crime*", Review of Economics and Statistics, 82 (4): 530-539.

Kuo, F. E. and Sullivan, W. C. (2001). "*Environment and Crime in the Inner City: Does Vegetation Reduce Crime?*", Environment and Behavior, 33 (3): 343-367.

Levinson, A. and Taylor, M. S. (2008). "*Unmasking the Pollution haven Effect*", International Economic Review, 49 (1): 223-254.

Lin, M. J. (2009). "*More Police, Less Crime: Evidence from US State Data*", International Review of Law and Economics, 29 (2): 73-80.

Mehlum, H., Moene, K. and Torvik, R. (2005). "*Crime Induced Poverty Traps*". Journal of Development Economics, 77 (2): 325-340.

Panayotou, T. (2016). "*Economic Growth and the Environment*", The Environment in Anthropology, p. 140-148.

Pease, Ken. The Carbon Cost of Crime and Its Implications, London, ACPO Secured by Design, 2009.

Richmond, A. K., & Kaufmann, R. K. (2006). "*Is There A Turning Point in the Relationship between Income and Energy Use and/or Carbon Emissions?*", Ecological Economics, 56 (2): 176-189.

Selden, T. M. and Song, D. (1994). "*Environmental Quality and Development: is There a Kuznets Curve for Air Pollution Emissions*?", Journal of Environmental Economics and Management, 27 (2): 147-162.

Shahbaz, M., Mutascu, M. and Azim, P. (2013). "*Environmental Kuznets Curve İn Romania And The Role Of Energy Consumption*", Renewable and Sustainable Energy Reviews, no: 18, p. 165-173.

Skudder, H., Brunton-Smith, I., Cole, J., McInnes, A., and Druckman, A. (2017). "*The Falling Carbon Footprint of Acquisitive and Violent Offences*", The British Journal of Criminology, 58 (2): 351-371.

Team, C. W., Pachauri, R. K., & Meyer, L. A. (2014). IPCC, 2014: climate change 2014: synthesis report. Contribution of Working Groups I. *II and III to the Fifth Assessment Report of the intergovernmental panel on Climate Change. IPCC, Geneva, Switzerland*, *151*.

Watson, R. T., Patz, J., Gubler, D. J., Parson, E. A., & Vincent, J. H. (2005). "*Environmental health implications of global climate change*", Journal of Environmental Monitoring, 7 (9): 834-843.

World Development Indicators. The World Bank. [Online] Available at: <http://datatopics.worldbank.org/world-development-indicators/>, [Erişim tarihi: 01.10.2018].