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## The effect of socioeconomic factors on crime rates in Romania: a macro-level analysis

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### ABSTRACT

The article outlines the need to identify appropriate explanations for various acts of deviant behaviour, mental illness and violent reactions in Romanian contemporary society which is facing a crisis of values and character. The objective of the article is to provide empirical evidence and raise awareness regarding the relationship between crime and socioeconomic factors in Romania over the period 1990–2014, based on statistics for testing co-integration theory and causal relationships. Specifically, the proposed analysis intends to capture the complexity of socioeconomic pressures on individuals and to clarify the ways in which the vitiation of modern society represents a manifestation of implemented economic mechanisms. By using data related to income, unemployment, inflation, inequality, development, education and population density as socioeconomic factors and also data on crime divided by region and type, the article supports the hypothesis of significant causality between socioeconomic factors and crime. Two directions can be considered for revealing the general result of the proposed analysis: one is that an increase in income inequality has a strong and robust effect regarding crime rates rising, and the second reveals that the place of residence is essential, the urban agglomeration being a generating factor for crime.

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## 1. Introduction

In recent years, like other European Union members, Romania has faced a series of effects on the social environment, induced by the economic crisis, having a significant impact on the perception of moral and social values. One social event, with major effects on human relations, is crime, present due to the lack of social comfort and the general state of the harsh Romanian reality.

Tackling crime can be achieved only from a multidisciplinary perspective, to highlight all its features. One can emphasise the prevention policies to fight against corruption at the social level, the establishing of guilt, the proper ranking of the offence or, even more

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elaborately, consider the forms of terrorism manifestation. Difficulties in conceptualising crime derive from its various manifestations, both for institutions and individuals, with profound effects and consequences on the economic, social and legal sense.

The etiological and causal perception of crime requires the expertise of criminal attitude determination. More accurately, the way in which individuals perceive the context in which they reveal it, the given importance for the means of satisfying the needs and, last, but not least, the education level and the mental capacity to distinguish between legal and illegal means.

Crime analysis in Romania is beneficial both because of its consideration as a factor generating a great interest for the source country and its institutions, but also due to the migration of crime in other European countries. Such research can generate suggestions on developing short-, medium- and long-term forecasts regarding the demographics and felony matters for different regions, areas and countries or can even be the beginning of law acts or shaping appropriate sectoral policies.

This study is composed of five parts, in a balanced structure. The analysis of the related studies in the second part of the study follows the opening section. The third part comprises the methodology of the study while the fourth section includes the evaluation of the findings. Finally, the conclusions, limitations of the study and recommendations for further research complete the final section.

## **2. Literature review**

Understanding the diversity of the internal causes, by considering individual human nature and external causes aimed towards cultural, economic, legal or political factors, is essential to capture the causal determinism of crime. Consequently, the attention is focused on the economic standards, education or population density distribution in urban and rural areas, but there is also a similar interest in the crisis of authority or social crisis across Romanian society.

### ***2.1. The relevance of assessment methods in crime areas***

Thanks to rich and varied criminology and victimology, statistical databases have been created with a basis in science, unitarily conceptualised in the EU member countries. The encountered difficulties occur because the crime phenomenon represents a social phenomenon that cannot consider all the facts that may constitute crime in the same way, in all countries. Therefore, the statistics do not include a series of offences, such as attempted murder, infanticide, sexual corruption, pimping, sexual harassment, violence or child sexual abuse. Moreover, a particular type of crime such as domestic violence, domestic or verbal violence are expressed separately, but tangentially, being included in various forms of offences against a person.

Despite these limitations, literature and a series of state institutions with attributes in the field of combating and preventing criminal activity, take into consideration the aggregate forms of crime: legal crime, real crime, apparent crime, dark figure of crime, juvenile delinquency, cybercrime, emphasising organised crime.

The distinction between the official and other types of public statistics consists in the fact that the official is important, being elaborated on and issued according to normative

documents or national and/or European regulations, in particular fields and is carried out by public authorities according to legal regulations.

European Union statistics defines six crime categories for reflecting the diversity of policy and legal systems within the EU: homicide, violent crime, robbery, domestic burglary, motor vehicle theft and drug trafficking. As a general rule, comparisons using these statistics should be based on trends rather than superior upper levels, on the assumption that the characteristics of the recording system within a nation remain relatively constant over time.

The statistics provided by the official Eurostat website and Tavares, Thomas, and Bulut (2012) show that the differences between countries occur due to a variety of factors. These factors include independent legal and criminal justice systems. Relevant examples represent the proportion of crimes reported to the police and recorded by them and differences in the timing of recording crimes, whether they are being reported to the police, or a defendant is identified. Likewise, differences in the rules by which multiple offences are counted and differences in the list of crimes that are included in the overall crime figures.

The Romanian National Statistics Institute provides official national statistics in the justice field. The crime is the deed presenting social instability, committed with guilt and supplied by penal law, while the conviction represents the enforcing, by a court order, of the punishments comprised in the criminal law, supposing the court finds that the existing fact is an offence, and the defendant has committed it.

The Romanian National Statistics Institute data in the field of crime encloses public administrative sources, respectively: the Ministry of Justice, the Superior Council of Magistracy and the General Inspectorate of Romanian Police within the Ministry of Administration and Interior. The Ministry of Justice provides information on convicted persons from penitentiaries and re-education centres. The Superior Council of Magistracy supplies information on the activity of judges, courts of law and appeal courts (penal and civil actions, convicted persons, criminality rate). The General Inspectorate of Romanian Police within the Ministry of Administration and Interior distributes data regarding the offences investigated by the police.

The sole official statistics referring to the crime phenomenon, publicly available from the website of the National Statistics Institute, based on data collected from other public administrative sources will be taken into consideration in the article, for obtaining a high level of assurance.

Therefore, we are aware of the performed research limits, generated by the insufficiency of the collected data, due to the limited period of analysis or due to the incorrectness of the official reports, caused by the amount of committed but undetected crimes or even the detected ones but which are not reported.

Also, we manifest reserve concerning the effectiveness of the legal framework regarding the elimination of significant discrepancies in defining different types of crime, because the statistical data in Romania does not use specialised taxonomies, and it is not clearly conceptualised. The biggest differences arise between the measurements based on victimisation and the official statistics including the criminal phenomenon in the economic field. To an equal extent, difficulties and limits of using illicit statistical data are also generated by the institutional capacities, legislative reforms and decisions implemented for the improvement of the reports produced by the increased requests of individual international monitoring institutions and especially civil society. Thus, the consequence of these changes at the level of institutional structures creates a terminological inconstancy, the inclusion of a new set

of statistical data, which do not provide historical analyses and comparisons with other countries' statistics.

A relevant example is considering the way of reporting the economic and non-economic crime. Similarly to existing literature (Topcu, Kuloglu, Erdogan, & Lobont, 2012), the Eurostat six categories of crime could be divided into two groups to determine whether the offence is or is not an economic phenomenon for the EU. The first group includes robbery, domestic burglary, motor vehicle theft and drug trafficking, which are crimes induced by financial gain. The second group includes homicide and violent crime that are not crimes relatively caused by financial gain. However, considering the data set regarding economic-financial and judiciary crime, we notice this classification is directly reported by the Romanian National Institute of Statistics, as offences investigated by the police refer to the main types of *regarding the relationships between crime and socioeconomic factors in Romania* offences in the reference year.

In this article, we consider the official crime data provided by the Romania National Statistics Institute, a specialised body of central public administration, with legal personality, subordinated to the government.

## **2.2. Connections between socioeconomic area and crime**

For understanding crime, its repercussions and the increased likelihood of relapse, a prominent place in literature is occupied by its causal explanation and, accordingly, by highlighting its determinants. Modern research has established that the field identifies three major categories of crime risk factors: (1) biological factors; (2) socioeconomic factors; and (3) psychological factors, whether as a result of a bottom-line orientation, or of the individual value system of those involved in criminal activity.

By investigating studies concentrated on analysing the relationship between crime and macroeconomic variables, Diaw, Lobonț, and Moldovan (2014) note the record of some contradictory results, related to the relationship between economic conditions and crime.

The literature comprises a large number of studies testing the Becker hypothesis, according to which the propensity to commit crime depends on the comparison between the expected costs and the benefits of legal and illegal activities (Becker, 1968; Ehrlich, 1973). The studies examine the relationship between economic and crime variables, pairwise, such as inequality-unemployment, unemployment-crime and inequality-crime.

The reality of the last 20 years of Romanian society offers a comprehensive picture represented by endless economic, social, political or cultural changes. These resulted in a series of social and behaviour dysfunctions, a general state of anomie caused by the uncertainty and lack of perspective, the social polarisation and the expansion of the poverty phenomenon.

Given the new challenges generated by the conventional and/or unconventional, threats, the extent and consequences of crime events, a new strategic integrated approach is necessary for shaping the analysis which is undertaken in the article. This approach should take into account the particular situation of Romania and its vulnerabilities, including accountability of government institutions, but should also prioritise the actions to be supported from the funds intended for internal affairs.

By analysing the environmental crime, Europol (Socta, 2013), the European Union's law enforcement agency, has identified seven current threats that the Member States will have to consider when they will formulate courses of action regarding the fight against organised

crime. They refer to illegal migration, human trafficking, counterfeiting merchandise and health care and pharmaceutical products, economic crimes committed through 'ghost' type companies – illegal VAT reimbursement, production and trafficking of synthetic drugs; cybercrime and money laundering.

This work generates a set of practical implications at the national level. The scale and diversity of the crime phenomenon make necessary the analysis and identification of threats developed on the background of the deterioration of living standards, family environment and educational system degradation, relevant indicators to the proposed study. Increasing the economic gap between certain geographical areas as respects to living standards can generate social rejection and changes in crime.

Therefore, this article is based on the pillars of finding solutions about how crime should be handled and prevented, in the context of relevant socioeconomic factors and determinants of criminal behaviour selection. Two theories in criminology explain associatively the proposed analysis, given that behaviour fits undisputedly into individual patterns. On one hand, the *social disorganisation theory* explains criminal behaviour on account of a person's physical and social neighbourhood ecological characteristics. On the contrary, the *criminal motivation theory* suggests that economic stress may increase the incentive for individuals to engage in illicit behaviours.

Currently, some statistics and studies are trying to provide a solution about personal connections between socioeconomic and demographic variables and crime, indicating that the current crisis has much weight on the social environment and, therefore, on the offence factors that increase crime behaviour. According to *social disorganisation theory*, a series of studies reveal that social segregation in the urban environment creates fragile environments. These are directly associated with high crime rates, according to Cahil (2004), Bjerck (2009), Raphael and Sills (2006). Moreover, the direct correlations between the rural environment and criminal behaviour turn out to be manifestations unique to Romania (Albu, Lobonț, Moldovan, & Kuloglu, 2013).

Also, similar to the existing literature framed in *criminal motivation theory* coordination, the article considers two crime categories – economic and judiciary – to determine whether or not the offences are an economic phenomenon for Romania. One way to explore this relationship is to examine how crime rates follow conventional economic indicators: inflation, unemployment, economic growth or level of poverty. The importance of both interpretation and perception of ways of meeting the individual needs, and the educational and intellectual capacity to distinguish between legal and illegal means necessary to obtain benefits should also be considered for identifying the etiological cause of crime (Becker, 1968).

Gümüș (2004) uses data from 75 large US cities for the period 1989–1991 to empirically examine the determinants of crime in urban areas. The obtained results, using an ordinary least squares (OLS) regression technique, indicate that the unemployment rate, police expenditure, income level, population, and primarily black communities are significant determinants of crime in urban areas.

The second socioeconomic problems of recent times is unemployment. Therefore, whether using data from a single country or having performed analyses on cross-country data or state-level observations, several studies confirm that unemployment increases crime: Raphael and Winter-Ebmer (2001), Edmark (2005), Buonanno (2006), Oster and Agell (2007) and Lin (2008). For instance, Fougère, Kramarz, and Pouget (2003), by using

a regional-level data set for the 95 departments of metropolitan France, examine the effects of unemployment on property crime and violent crime in France for the period 1990 to 2000 and verify that, in the cross-section dimension, crime and unemployment are positively associated. Within all these studies, there are different mechanisms through which unemployment can affect crime: alcohol consumption, substance abuse, drug dependence, income inequality, the availability of theft-worthy goods (Buonanno & Montolio, 2008; Gümüş, 2004; Omotor, 2009).

However, we find that the study of crime and its determinants are also closely related to other variables, such as social exclusion, educational level, cultural dimension, family background, religion.

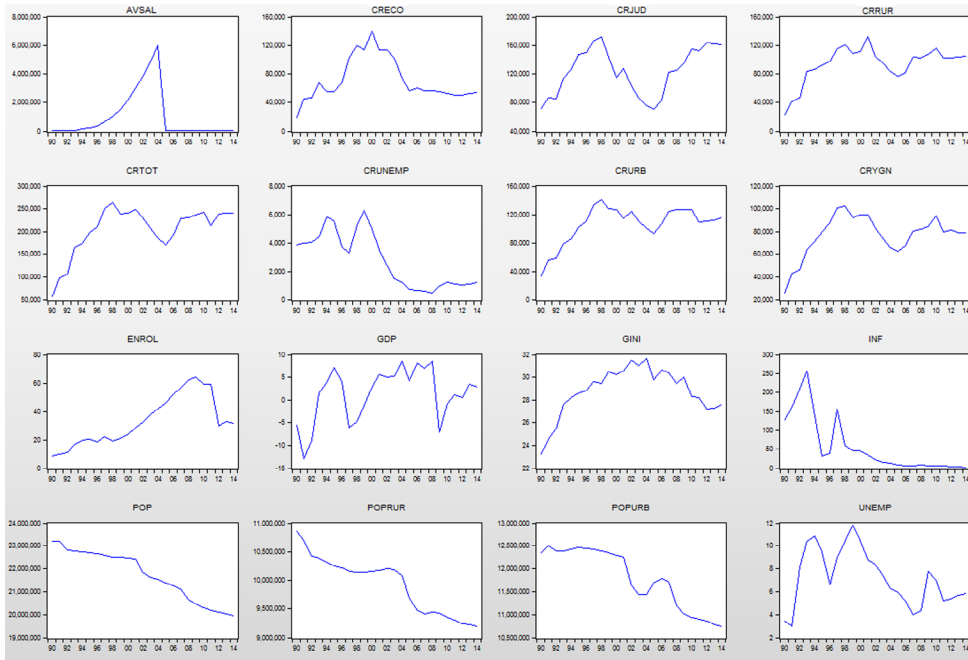
A recent study (Traxler & Burhop, 2010) confirms the strong positive effect of poverty on property crime and a substantial negative impact of poverty on violent crime, by using panel data methodology for Prussia during 1882 to 1910 and the rye price as a proxy for poverty. Moreover, by using binary choice models, Anderson (2002) finds a negative effect of poverty on crime, using as crime indicators assault, robbery, rape, murder and abduction in South Africa.

The underlying argument of the previous studies can be resumed by the fact that the socioeconomic factors and the effects induced by these factors are susceptible to change the criminal behaviour in a rationally way, to maximise their effectiveness. However, this article considers the article by Gillani, Rehman, and Gill (2009) as being a priority, investigating the relationship between crime and various economic indicators such as unemployment, poverty and inflation for Pakistan, using the Granger causality test, demonstrating a long-term relationship among all the variables. Socioeconomic factors, identified as relevant to previous studies in impacting crime, have been selected to achieve an empirical analysis in Romania, according to Table 2 (see Appendix 2).

The objective of the article is to provide empirical evidence for Romania based on the following hypothesis: *Crime and its dimensions are intrinsically and causally related to the practical socioeconomic aspect of society.* Consequently, the following sections describe the data, methodology and models used to evaluate the above hypothesis. The fourth and fifth section report the empirical results of the study and conclude the article.

### 3. Data, methodology and model

This study examined the relationship between some selected social and economic variables and the type of crimes in Romania. We have selected data annually over the period 1990–2014, provided by the Romanian National Institute of Statistics, Eurostat and World Bank. The model includes seven different type of crimes used as the dependent variable. The data of crime is divided into two categories depending on the region and type. Depending on the area where the crime occurred, it has been divided into five types. Therefore, the number of total crimes occurred across the country are denoted by CRTOT. The number of crimes taken place in the rural area is indicated by CRRUR while the number of crimes occurred in the urban area is denoted by CRURB. CRUNEMP denotes the number of offences carried out by unemployed people, and CRYNG indicates the number of crimes perpetrated by young people (18–30 age). According to the types of crimes, the number of economic crimes which occurred across the country are denoted by CRECO and the number of judiciary economic crimes occurred across the country are indicated by CRJUD.



**Figure 1.** Time series graph of crime and socioeconomic factors of Romanian reality. Source: Authors' processing.

The models use nine independent variables as the determinants of crime. These variables are respectively: income, inflation rate, gini coefficient, unemployment rate, economic growth level, the total population in Romania, the total population in Romania rural areas, the total population in Romania urban areas and the enrolment rate in Romanian universities.

Income shows the average monthly wage per person (denominated RON), and AVSAL denotes it. The inflation rate is calculated as the average annual percentage change, and INF indicates it. The gini coefficient represents the share percentage of the level of income inequality, and GINI symbolises it. The unemployment rate is the average annual percentage change denoted by UNEMP while the economic growth level is the average annual percentage change indicated by GDP. The total population in Romania is shown by POP while POPRUR, namely POPURB, denote its components, the total population in Romania rural areas and the total population in Romania urban areas. The enrolment rate in Romanian universities as a percentage share denoted by ENROL. Enrolment ratio is the ratio of those who went to college from the higher education level. Descriptive statistics for these variables are shown in Table 3 (see Appendix 2).

A time series graph of crime and socioeconomic variables is used in this article, for the period 1990–2014 and is represented by Figure 1. Due to the high differences between the value of series, the differences will be reduced by considering the logarithm of variables in the methodological section of the article.

The development of the criminal phenomena in Romania, for all categories of crime and people, with an increasing recrudescence after the 1990s, was the result of the supportive conditions due to the dysfunctionalities emerged in the regulatory and institutional



Romanian network. Therefore, we expect to discover which are the determining socio-economic factors of criminal behaviour over the last 20 years in Romania.

If changes regarding the territorial distribution of the population are less noticeable, due to the reduced variability of the proportion of urban and rural residents, the demographic dynamics of the early years, immediately after the 1990s, receive negative features, decreasing systematically. We took into consideration the demographic variable and the national distribution because the vast transformation of cities or urban agglomerations created an additional pressure on the socioeconomic elements, therefore producing favourable conditions for defective and criminal manifestations. Also, sustainable and efficient management of the urban and rural environment and highlighting the threats posed by crime equally involve considering the increase of police service quality and shaping programmes aimed at improving the citizens safety. The increase of police service primarily targets rural areas, by applying a coherent policy to prevent and combat crime. Shaping programmes aim to ensure an optimum business environment by reducing the corruption and tax evasion phenomenons.

We have chosen to use the multiple regression analysis to determine the relationship between crime, unemployment, salary, inflation, growth and density of the population. The multiple regression analysis represents a statistical technique that shows the individual effects of several explanatory variables on a single dependent variable.

The aim of this study was to examine the relationship of causality between socioeconomic variables and crime over the period 1990–2014 in Romania. Causal relationships between variables are usually tested with causality tests developed by Granger (1969). First, the series stationary analysis is required, since the Granger Causality Analysis is a time series analysis. The series stationary analysis considered in this study is carried out using an Augmented Dickey–Fuller (ADF) unit root test developed by Dickey and Fuller (1981) and a Phillips–Perron (PP) test, developed by Phillips and Peron (1988). The ADF and PP tests are conducted for selecting the right model when causality test runs. The Dickey–Fuller (DF) (1979), ADF (1981) and PP (1988) tests are commonly used for testing the stationary of the implied variables in empirical applications. Therefore, we have also chosen to use these tests in this study.

A DF unit root test is adopted in the current research since the error terms are supposed to be statistically independent and to have constant variance. Regarding the autocorrelation problem in the ADF test, the dependent variable lag must be parallel with the optimal lag length, so the DF equation uses it as an independent variable.

$$\Delta y_t = \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_{1t} + \beta_1 \Delta y_{t-1} + \varepsilon_t \quad (3)$$

The test can be performed by using the types of equations (1), (2) and (3) above to reveal the models without intercept + trend, with only intercept and intercept + trend. The equations check whether  $\gamma = 0$  and if the null hypothesis is stating that the series has a unit root was rejected, that would suggest that series are stationary.

In statistics and econometrics, PP unit root test is a non-parametric modification of the standard DF test and permits error term to be dependent at a low level and distributed

heterogeneously (Enders, 2004, p. 229). Phillips and Peron rely on nonparametric statistical methods to take care of serial correlation in the error terms without adding lagged difference terms (Gujarati, 2004, p. 818). The asymptotic distribution of the PP test is the same as the ADF test statistics; it is not, therefore, required to include formalisation.

The Granger test (1969) proves to be useful when exploring whether there is a cause and effect relationship between the variables of the above model, and to identify the existence and direction of this relationship, namely Granger causality analysis. It is a pre-requisite to explore the stationarity of the variables before proceeding to the Granger causality test. Therefore, a first step in the performed empirical study was to investigate the stability of the series before the identification of the relationship between variables. In this regard, Granger and Newbold (1974, pp. 111–120) stated that the regression analysis among the variables will not be consistent, and a spurious regression problem will occur if unstable data are used.

When statistical modelling identifies an association between one or more socioeconomic variables and crime outcomes, the model frequently indicated a lag time between changes in the socioeconomic variable and resultant impact on crime levels. The analytical model, chosen to determine the type of the relationship between socioeconomic and crime variables, is formalised as it follows:

$$\begin{aligned} \Delta LCRTOT_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \lambda_i \Delta LPOP_{t-i} \\ & + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} \\ & + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} + \mu_{it} \end{aligned} \quad (4)$$

In another general economic specification of the model, other commercial specifications are examined about sub-types of crime as it follows:

$$\begin{aligned} \Delta LCRECO_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \lambda_i \Delta LPOP_{t-i} \\ & + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} \\ & + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} + \mu_{it} \end{aligned} \quad (5)$$

$$\begin{aligned} \Delta LCRJUD_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \lambda_i \Delta LPOP_{t-i} \\ & + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} \\ & + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} + \mu_{it} \end{aligned} \quad (6)$$

$$\begin{aligned} \Delta LCRURB_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} \\ & + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} \\ & + \sum_{i=1}^l \lambda_i \Delta LPOPURB_{t-i} + \mu_{it} \end{aligned} \quad (7)$$

$$\begin{aligned} \Delta LCRRUR_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} \\ & + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} \\ & + \sum_{i=1}^l \lambda_i \Delta LPOPRUR_{t-i} + \mu_{it} \end{aligned} \quad (8)$$

$$\begin{aligned} \Delta LCRYGN_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} \\ & + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} \\ & + \sum_{i=1}^l \lambda_i \Delta LPOP_{t-i} + \mu_{it} \end{aligned} \quad (9)$$

$$\begin{aligned} \Delta LCRUEMP_t = & \sum_{i=1}^l \alpha_i \Delta LAVSAL_{t-i} + \sum_{i=1}^l \beta_i \Delta LINF_{t-i} + \sum_{i=1}^l \delta_i \Delta UNEMP_{t-i} \\ & + \sum_{i=1}^l \gamma_i \Delta GDP_{t-i} + \sum_{i=1}^l \alpha_i \Delta GINI_{t-i} + \sum_{i=1}^l \alpha_i \Delta ENROL_{t-i} \\ & + \sum_{i=1}^l \lambda_i \Delta LPOPRUR_{t-i} + \mu_{it} \end{aligned} \quad (10)$$

In these equations, left-side variable is the logarithm of crime data represented by  $\Delta LCR$  ( $\Delta$  indicates that the series has taken the first difference), and the right-side variables are the logarithms of the most significant determinants of crime models: unemployment, salary, inflation, growth and density of population. Two crime categories are considered, namely: (1) total offences investigated by the police; and (2) crimes investigated by the police.

Total offences investigated by the police include the aggregate level and the level in the urban and rural area, denoted by  $\Delta LCRTOT$ ,  $\Delta LCRURB$  and  $\Delta LCRRUR$ .  $\Delta LCRECO$  and  $\Delta LCRJUD$ , indicate crimes investigated by the police, according to types of crimes, economic and judiciary types of crime. The determinants of crime models are income denoted by  $\Delta LAVSAL$ , inflation is denoted by  $LINF$ , the unemployment rate is denoted by  $\Delta UNEMP$ , and economic growth level is denoted by  $\Delta GDP$ , the density of population is

denoted by  $\Delta$ LPOP, the enrolment rate is denoted by  $\Delta$ ENROL and the Gini coefficient is denoted by  $\Delta$ GINI.

In the first stage, the long-term relationship between variables will be investigated using autoregressive distributed lag (ARDL) bounds testing and Value at Risk (VAR) method. In the second phase, causal relationships between variables will be explored with the help of causal models based on Error Correction Model and Toda–Yamamoto approach to Granger Causality Test (TYDL).

Engle and Granger's two-step approach (1987) based on the error term, Johansen (1988) and Johansen and Juselius (1990) method based on the system approach is the most commonly used co-integration test in the literature. For the implementation of this method, all variables in the model have to become stationary for first difference of variables and not stationary  $I(0)$  on the level (Pesaran, Shin, & Smith, 2001, pp. 289–290). The implementation problem of the co-integration method on the series with different degrees of co-integration is solved by limit test approach developed by Pesaran and Shin (1995) and Pesaran et al. (2001). This new method is expressed as the ARDL approach. The advantage of this approach is in the research of the existence of the co-integration relationship between variables regardless of the degree of variables' integration. On the other hand, applying this method is appropriate, depending on three factors. First, the limit test procedure is straightforward and in contrast to the multivariate co-integration method such as Johansen and Juselius (1990), the existence of co-integration relationships are determined after the length of the lag in the model is estimated by OLS. Secondly, limit test procedure as different from Johansen and Juselius (1990), co-integration techniques do not require any pre-test for variables included in the unit root test model. Thirdly, the limit test is highly useful for small or limited sample sets. The length of the lag necessary to determine for the implementation of the limit test. To ascertain the duration of the delay utilised from information criteria such as Akaike information criterion (AIC), Schwarz criterion (SC), "Final Prediction Error" criterion (FPE) and Hannan-Quinn criterion (HQ). In this case, the length of lag provides the smallest critical value is determined by the length of delay of the model.

The presence of co-integration relationship was determined by applying collectively F-test (Wald test) on the coefficient of the first period lag of the dependent and independent variables. F-tests are tested null ( $H_0$ : there is no co-integration between variables) and alternative hypothesis ( $H_1$ : There is co-integration between variables). It is necessary to reject the null hypothesis for to be co-integration between variables. Because of critical values obtained by Pesaran et al. (2001) generated from a vast number of observations (between 500 and 1000), in the case of small sample mass, critical values will deviate significantly and should be known to give misleading results. Because the sample size is 25 in our study, the critical value proposed by Narayan (2005) is used. Whether there is co-integration between variables will be decided as follows: if the calculated F-statistic value exceeds the critical upper limit, the null hypothesis will be rejected. However, the calculation of the F-statistic value is lower than the lowest critical limits; the null hypothesis will be accepted.

After investigating the co-integration between the data in the study, Granger causality is tested using two different methodologies. In the first approach, Granger causality tests with Vector Error Correction Model (VECM) are carried out. While in the short- and long-term, the Granger causality test and VECM approaches are used, the TYDL approach is deemed advantageous in terms of not requiring a pre-test merely for examining short-term causality.

If we consider the Granger causality approach based on VECM, Granger causality test is introduced by adding a lagged error correction term in the case of co-integration series.

The absence of long-term relationships between variables requires the presence of Granger causality, for at least one direction between variables. In the event of the absence of a long-term relationship, Granger causality tests take as below the form of (VECM) multivariate at the level of  $p$ .

$$\begin{aligned}
 (1-L) \begin{bmatrix} \Delta LCRTOT_t \\ \Delta LCRECO_t \\ \vdots \\ \Delta LCRYGN_t \\ \Delta LCRUEMP_t \end{bmatrix} &= \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_{15} \\ \alpha_{16} \end{bmatrix} + \sum_{i=1}^p (1-L) \begin{bmatrix} \beta_{11i} & \cdots & \beta_{1,16i} \\ \vdots & \ddots & \vdots \\ \beta_{16,1i} & \cdots & \beta_{16,16i} \end{bmatrix} \\
 &+ \begin{bmatrix} \Delta LCRTOT_{t-1} \\ \Delta LCRECO_{t-1} \\ \vdots \\ \Delta LCRYGN_{t-1} \\ \Delta LCRUEMP_{t-1} \end{bmatrix} + \begin{bmatrix} \gamma \\ \delta \\ \vdots \\ \epsilon \\ \vartheta \end{bmatrix} [ECT_{t-1}] \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_{15} \\ \epsilon_{16} \end{bmatrix} \quad (11)
 \end{aligned}$$

In addition to the defined variables in equation (11), difference processor is denoted by  $(1-L)$ , and error terms are indicated by  $\epsilon_1, \epsilon_2, \dots, \epsilon_p$ . The F statistics of delayed explanatory variables in the error correction model shows the significance of short-term causal effect and similarly t-statistic of the coefficient of the lagged error correction term demonstrates the importance of the long-term the causal effect. The appropriate length of the delay is determined based on Schwarz information criterion (SBC) and/or the Akaike information criteria (AIC).

#### 4. Findings

In this study, we used ADF and PP unit root tests to determine stationary of series and AIC to determine the length of the lag of variables. Table 4 (see Appendix 2) presents the evaluation results of ADF unit root test; one can observe that variables are not stationary in their levels; for the tests of all models have an only intercept, intercept + trend and none, excepting the inflation variable.

Table 5 (see Appendix 2) presents the stationary analysis results of the series for PP test; one can observe that variables are not fixed in their levels; for the tests of all models they have an only intercept, intercept + trend and none, excepting the inflation variable.

Table 4 and Table 5 (see Appendix 2) present unit root tests results. According to these findings, the results indicate that the whole series has a unit root, being not stationary. Therefore, when the unit root test is applied again taking first difference of series, the conclusion is that the entire series has not a unit root, being stationary. Therefore, as a result of the ADF and PP unit root tests, all series can be considered  $I(1)$ , namely integrated series of order 1.

After concluding on the stationarity of the series, when taking difference series, we will start the co-integration analysis. Due to the abundant number of variables, in models 4–10, we cannot provide a sufficient number of observations. So, according to the OLS models, we will raise the little explanatory power of variables from the model. We will use variables

$\Delta\text{LCRTOT}_t$ , in model 4,  $\Delta\text{LCRECO}_t$ ,  $\Delta\text{LINF}_{t-1}$ ,  $\Delta\text{GINI}_{t-1}$  and,  $\Delta\text{LAVSAL}_{t-1}$  in model 5,  $\Delta\text{LCRJUD}_t$ ,  $\Delta\text{LAVSAL}_{t-1}$ ,  $\Delta\text{GINI}_{t-1}$  and in model 6,  $\Delta\text{LCRURB}_t$ ,  $\Delta\text{LAVSAL}_{t-1}$ ,  $\Delta\text{GINI}_{t-1}$  and in model 7,  $\Delta\text{LCRRUR}_t$ ,  $\Delta\text{LAVSAL}_{t-1}$ ,  $\Delta\text{LPOPRUR}_{t-1}$  and in model 8,  $\Delta\text{LCRYGN}_t$ ,  $\Delta\text{LAVSAL}_{t-1}$ ,  $\Delta\text{LPOP}_{t-1}$  and in model 9,  $\Delta\text{LCRUEMP}_t$ ,  $\Delta\text{LAVSAL}_{t-1}$ ,  $\Delta\text{GDP}_{t-1}$ ,  $\Delta\text{UNEMP}_{t-1}$  and in model 10.

We will use Variance Inflation Factor (VIF) and Tolerance Value (TV) for the detection of multiple linear connection problems. If VIF is greater than the value 10, various connection problems arise. If the obtained values are close to 1, there is evidence of the absence of multi-connection issues (Field, 2005). Similarly, if TV is smaller than the value of 0.1, multiple connection problems appear. Respectively, we found VIF=1.179 and TV=0.894 in model 4, VIF=1.221 and TV=0.876 in model 5, VIF=1.109 and TV=0.823 in model 6, VIF=1.110 and TV=0.901 in model 7, VIF=1.289 and TV=0.904 in model 8, VIF=1.134 and TV=0.753 in model 9, VIF=1.432 and TV=0.732 in model 10. By analysing the TV and VIF values, we found that there is no linear connection between multiple variables.

The null hypothesis in Johansen co-integration method is established for no co-integration between variables. When these results are analysed in our models, it seems it has been found to be at least the one co-integration. After co-integration was detected between variables in the long- and short-term in our models, we can observe the Granger causality test results in Table 7 (Appendix 2).

When analysing Granger causality test results in our models, Table 7 reveals the Granger causality in the model (4) of DLINF variables with DLCRECO variables. This shows that economic crime is affected by inflation rates. In model (5), we found Granger causality between DLAVSAL and DLCRJUD, showing that judiciary crimes are affected by average salary variables. In model (6), rural area crimes are influenced by the rural population. In model (7), all offences variables are affected by average income. In model (8), the crimes of unemployment are affected by inflation rates and unemployment rates. In model (9), crimes in the urban area are affected by urban population and average salary variables. Finally, in the model (10), crimes committed by youth is influenced by average salary variables.

The general result of proposed analysis is divided into two directions. One is that an increase in income inequality has a big and robust effect of increasing crime rates, and second reveals that residence environment is essential, urban agglomeration being generating factors for crime. These results confirm the two considered criminological theories.

The fact that economic crime is affected by the inflation rates (model 4) brings to attention an intriguing twist on an old debate between economists and criminologists, due to direct incidence generated by the inflation rate. Price growth may increase demand for goods on the black market. The growth of the underground economy may increase motivation to get goods illicitly/through evasion, either for personal consumption or to integrate them later in a bootleg circuit. Felson and Clarke (1998) note that crime is an intriguing phenomenon, and recession periods are generating opportunities to commit crimes.

Secondly, judiciary crime is affected by average salary variables (model 5), and all crime variables are affected by average income (model 7), results fundamented by Fajnzylber, Lederman and Loayza (2002). In a study conducted by the World Bank, the Fajnzylber, Lederman and Loayza (2002) discovered that crime rates and inequality are positively correlated within countries and also between countries, and it appears that this correlation reflects causation from difference to crime rates, even controlling for other crime determinants.

If we consider correlating two of the analysis results, namely the causality relation generated by the income level for all types of crime (model 7) and the rural environment crime (model 6), these results can be explained through the vulnerabilities of people coming from the rural environment. Due to the lack of employment opportunities in the rural environment, the adherence to social sub-cultural values, the low level of knowledge and a reduced standard of living, people adopt a faulty behaviour in respect to the rules. The same results are positive in the model (9), crimes in the urban area being affected by urban population and average salary variables. Some studies support the hypothesis that the increase in the level of urbanisation is followed by the same effect for criminality. (Galvin, 2002; Gaviria & Pagés, 2002, Gümüş, 2004).

## 5. Discussion and conclusions

We are aware that the estimation strategy as described above may suffer from omitted variables not conventionally considered in this article as significant determinants of crime, such as the level of democracy (Lin, 2007) or immigration (Bianchi, Buonanno, & Pinotti, 2012). Therefore, new research directions arise.

If considering the economic crime category, *the unidirectional causality between the economic crime and the inflation rate* highlights that economic criminality represents one of the determining factors of Romania's measure of inflation. The economic crime includes tax evasion-type crimes, frauds in trade relations, document forgeries, defalcation, financial secret revelations, abuse of office, as well as the crimes regulated by other laws.

The regulatory framework of criminal law has evolved, determining a high legal structure for the fight against and prevention of the economic crimes. Nevertheless, economic and financial development of Romanian society leads to the consideration of different types of criminal manifestations, among which an alarming level of corruption. National strategies to ensure consistency in policymaking for preventing and fighting against the underground economy must consider the category of economic crime. Economic crime includes those mentioned above, as well as offences covered by the Law No.86/2006 on the Customs Code, offences covered by the Law No. 571/2003 regarding the Fiscal Code and other offences covered by special laws.

Such benchmarks require focus within organised crime and the level of created damage. The gravity, repeatability and material damage accumulation associated with these types of crime can be further benchmarks for transnational organised crime. Undertaken measures must be mirrored by national and European legislation in the field of citizen safety, by taking into account the particular situation of Romania and its border vulnerabilities, including prioritisation of actions to be supported by the internal affairs funds.

The potential risks associated with chronic unemployment in Romania can also be noticed, both in terms of the person experiencing this phenomenon and the social point of view. National strategies should aim explicitly criteria to reduce this risk, visible in diminishing professional skills, invalidity complex for society and family, profound social conflicts, inferiority complex and the general state of anomie, and also the need to ensure the marginal utility of unlawful income.

Therefore, the Romanian environment enforces efficient management of urban and rural areas, highlighting the main threats posed by crime. This process involves the similar matter of increasing the level of the police service, especially in the rural environment, by enforcing

a coherent policy regarding the prevention and fighting off the criminal phenomenon, by providing the continuity of surveillance duty and intervention to incidents.

Once more, the result highlights the importance of studying deviant behaviour because the abnormal response mainly differs from the accepted and recognised norms and values in a social system. In this manner, one can emphasise the actual or potential threat to the economic and social life safety, being useful for informing long-term policies that aim at making crime less sensitive to economic factors, through social and labour market improvement. Tackling income inequality must complement the efforts undertaken by the law and justice system to reduce the rising crime rates.

Romania's geographical position creates the potential for being a favourable climate for a large international trafficking network, respectively a gateway for products and goods coming from emerging markets. Therefore, targeting the control actions especially within customs and port infrastructure to reduce illicit activities when entering the national territory is appropriate.

On this background, in the context of internally-facing economic and social difficulties, a high degree of crime flexibility, both as a source and as a transit country has been identified in Romania. Therefore, a European-focused effort to extend and intensify international cooperation with Romania is fully required. Likewise, the participation of internal structures with responsibilities in crime field is imperative in developing and implementing the EU policy cycle.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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## Appendix 1:

### Lag length structure.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-34.42085	NA	0.110035	3.468653	3.568131	3.490242
1	-31.23368	5.463725*	0.119343*	3.546065*	3.844500*	3.610833*
2	-30.48936	1.134201	0.165135	3.856130	4.353521	3.964076
3	-29.92964	0.746302	0.237160	4.183775	4.880123	4.334900

\*indicates lag order selected by the criterion.

Source: Authors' calculations.

## Appendix 2

**Table 1.** Crime descriptors for Romania.

Variable	Unit of measure	Definition	Data source
Crime total	Number of people	Crimes are offences investigated by the police in the reference year while persons charged are the persons under criminal investigations for crimes committed.	Romanian Police General Inspectorate of the Ministry of Administration and Interior, provided by the NATIONAL INSTITUTE OF STATISTICS, <a href="http://statistici.insse.ro">http://statistici.insse.ro</a>
Crime rural area			
Crime urban area			
Foreigners			
Crime unemployed			
Crime young people (18–30)			
Crime economic-financial			
Crime Judiciary			

Source: Authors' processing, <http://statistici.insse.ro>.

**Table 2.** Descriptors of socioeconomic context.

Variable	Unit of measure	Definition	Data source
Unemployment rate	%	Registered unemployment rate represents the ratio between the number of unemployed and civil economically active population (unemployed + civilian employed)	National Agency for Employment, provided by the NATIONAL INSTITUTE OF STATISTICS, <a href="http://statistici.insse.ro">http://statistici.insse.ro</a>
Real GDP growth rate – volume	%	For measuring the growth rate of GDP in terms of volumes, the GDP at current prices are valued in the prices of the previous year and the thus computed volume changes are imposed on the level of a reference year.	European Commission, Eurostat, <a href="http://ec.europa.eu/eurostat">http://ec.europa.eu/eurostat</a>
HICP - Inflation rate - Annual average rate of change	%	Harmonised Indices of Consumer Prices (HICPs) are designed for international comparisons of consumer price inflation.	European Commission, Eurostat, <a href="http://ec.europa.eu/eurostat">http://ec.europa.eu/eurostat</a>
Population total	Number of persons	Usual resident population represents all people of Romanian nationality, foreign or stateless who have their habitual residence in Romania.	The statistical survey on Romania's resident population, provided by the NATIONAL INSTITUTE OF STATISTICS, <a href="http://statistici.insse.ro">http://statistici.insse.ro</a>
Urban Population	Number of persons	Usual residence is the place where a person normally spends the daily period of rest, regardless of temporary absences for purposes of recreation, holidays, visits to friends and relatives, business, medical treatment or religious pilgrimage.	
Rural Population	Number of persons		
Average net nominal salary	Lei, namely Lei (RON) (from 2005)	The average monthly earnings represent the ratio between the amounts paid to the employees by economic units in the reference month, no matter of the period and the average number of workers.	Labour cost survey, provided by the NATIONAL INSTITUTE OF STATISTICS, <a href="http://statistici.insse.ro">http://statistici.insse.ro</a>
GINI index	Ratio	Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality while an index of 100 implies perfect inequality.	World Bank, Development Research Group, <a href="http://iresearch.worldbank.org/PovcalNet/index.html">http://iresearch.worldbank.org/PovcalNet/index.html</a>
Unemployment with primary education (% of total unemployment)	%	The unemployed, according to International Labour Office definition, are persons aged 15–74 years who in the reference period simultaneously fulfil the following conditions:	Household labour force statistical survey, provided by the NATIONAL INSTITUTE OF STATISTICS, <a href="http://statistici.insse.ro">http://statistici.insse.ro</a>
Unemployment with secondary education (% of total unemployment)	%	– have no job and do not carry out an activity to get income;	
Unemployment with tertiary education (% of total unemployment)	%	– are looking for a job, in the last four weeks (including the reference week); – are available to start work in the next two weeks (including the week when the interview is carried out), if they find a job at once.	

*(Continued)*

**Table 2.** (Continued)

Variable	Unit of measure	Definition	Data source
School enrolment, primary (% total)	%	Enroled population includes all children in nurseries and kindergartens and students enroled in the formal training and educational process during a school/academic year, regardless of the educational form (full-time, evening classes, part-time classes, or distance learning), study programme or age.	Statistical surveys carried out at the beginning of school year (academic year) in educational units
School enrolment, secondary (% total)	%		
School enrolment, tertiary (% total)	%		

Source: Authors' processing.

**Table 3.** Descriptive statistics of the variables.

(D)	AVSAL	CRECO	CRJUD	CRRUR	CRTOT	CRUNEMP	CRURB	CRYGN
Mean	949,966.8	71,212.32	123,823.3	93,720.32	203,944.5	2,754.080	106,186.0	76,570.52
Median	20,140.00	56,356.00	126,429.0	102,788.0	228,536.0	2,426.000	111,004.0	80,000.00
Maximum	5,986,386.	139,600.0	171,758.0	131,733.0	263,939.0	6,293.000	140,674.0	102,500.0
Minimum	746.0000	18,618.00	70,344.00	22,786.00	56,282.00	442.0000	33,346.00	25,941.00
Std. Dev.	1,692,213.	30,088.43	33,318.04	25,149.76	52,315.79	1925.573	26,368.34	18,275.62
Skewness	1.819035	0.751392	-0.247357	-1.333056	-1.406326	0.356688	-1.256610	-1.035715
Kurtosis	5.132597	2.548390	1.699454	4.445846	4.258236	1.663861	3.962691	3.893384
Jarque-Bera	18.52450	2.564908	2.016834	9.581902	9.889764	2.389764	7.544838	5.301000
Probability	0.000095	0.277356	0.364796	0.008305	0.007120	0.302740	0.022996	0.070616
Sum	23,749,169	1,780,308.	3,095,582.	2,343,008.	5,098,612.	68,852.00	2,654,649.	1,914,263.
Sum Sq. Dev.	6.87E+13	2.17E+10	2.66E+10	1.52E+10	6.57E+10	88,987,968	1.67E+10	8.02E+09
Observations	25	25	25	25	25	25	25	25
(IN)	ENROL	GDP	GINI	INF	POP	POPRUR	POPURB	UNEMP
Mean	32.85868	1.292960	28.79200	56.26520	21,719,101	9,925,976.	11,793,126	7.236000
Median	29.94000	2.921000	29.44000	22.50600	21,833,483	10,146,210	11,780,104	7.000000
Maximum	63.76617	8.500000	31.66000	256.1050	23,211,395	10,858,714	12,499,114	11.80000
Minimum	8.308720	-12.92700	23.20000	1.400000	19,947,311	9,198,308.	10,749,003	3.000000
Std. Dev.	17.49583	5.846488	2.121043	73.11647	1,103,321.	495,143.5	648,667.9	2.485605
Skewness	0.447356	-0.796954	-0.981548	1.423899	-0.334644	-0.089677	-0.378611	0.118505
Kurtosis	1.930129	2.727593	3.528424	3.825190	1.637677	1.804868	1.547010	1.982262
Jarque-Bera	2.026181	2.723699	4.305183	9.157175	2.399866	1.521362	2.796422	1.137464
Probability	0.363095	0.256186	0.116183	0.010269	0.301214	0.467348	0.247039	0.566243
Sum	821.4671	32.32400	719.8000	1,406.630	5.43E+08	2.48E+08	2.95E+08	180.9000
Sum Sq. Dev.	7,346.500	820.3541	107.9718	128,304.4	2.92E+13	5.88E+12	1.01E+13	148.2776
Observations	25	25	25	25	25	25	25	25

Note: D and IN symbols in parenthesis indicates respectively dependent and independent variables. \*AVSAL is an independent variable.

Source: Authors' calculations.

**Table 4.** ADF unit root test.

variables <sup>1</sup>	H <sub>0</sub> : series has a unit root			Decision
	Intercept	Trend ± intercept	None	
ΔLAVSAL	-4.52[0.00]***	-4.60 [0.00]***	-4.63[0.00]***	H <sub>0</sub> :Reject
ΔLCRECO	-6.03[0.00]***	-5.97 [0.00]***	-6.26[0.00]***	H <sub>0</sub> :Reject
ΔLCRJUD	-3.53[0.01]***	-3.43 [0.07]*	-3.56[0.00]***	H <sub>0</sub> :Reject
ΔLCRTOT	-5.01[0.00]***	-5.14 [0.00]***	-5.00[0.00]***	H <sub>0</sub> :Reject
ΔLCRURB	-5.13[0.00]***	-5.32 [0.00]***	-5.16[0.00]***	H <sub>0</sub> :Reject
ΔLCRRUR	-4.83[0.01]***	-5.02 [0.00]***	-4.85[0.00]***	H <sub>0</sub> :Reject
ΔLCRYGN	-4.72[0.00]***	-4.73 [0.00]***	-4.85[0.00]***	H <sub>0</sub> :Reject
ΔLCRUEMP	-3.25[0.02]**	-3.17 [0.08]*	-3.25[0.00]***	H <sub>0</sub> :Reject
ΔLPOP	4.36[0.00]***	-4.30 [0.01]***	-2.66[0.01]***	H <sub>0</sub> :Reject
ΔLPOPURB	-4.04[0.00]***	-4.29 [0.01]***	-3.19[0.00]***	H <sub>0</sub> :Reject
ΔLPOPURR	-3.76[0.01]***	-3.65 [0.04]**	-3.11[0.00]***	H <sub>0</sub> :Reject
ΔLINF	-5.44[0.00]***	-5.32 [0.00]***	-4.36[0.00]***	H <sub>0</sub> :Reject
ΔUNEMP	-4.78[0.00]***	-4.48 [0.00]**	-4.93[0.00]***	H <sub>0</sub> :Reject
ΔLGINI	-2.70[0.04]**	-6.97 [0.00]***	-2.98[0.00]***	H <sub>0</sub> :Reject
ΔLENROL	-4.23[0.00]***	-5.11 [0.00]***	-4.08[0.00]***	H <sub>0</sub> :Reject
ΔGDP	-5.36[0.00]***	-5.40 [0.00]***	-5.41[0.00]***	H <sub>0</sub> :Reject

Notes: Numbers of lags used in ADF regressions were selected using AIC. Probability values of t-statistics are between the brackets. \*\*\*, \*\* and \* denote significantly at 1%, 5% and 10% respectively.

<sup>1</sup>In this and following table for unit root, Δ means first difference of the variables. All the variables are not in levels.

Source: Authors' calculations.

**Table 5.** PP unit root tests.

variables <sup>1</sup>	H <sub>0</sub> : series has a unit root			Decision
	Intercept	Trend ± intercept	None	
ΔLAVSAL	-4.52[0.00]***	-4.60 [0.00]***	-4.63[0.00]***	H <sub>0</sub> :Reject
ΔLCRECO	-5.98[0.00]***	-5.97 [0.00]***	-6.21[0.00]***	H <sub>0</sub> :Reject
ΔLCRJUD	-3.53[0.01]***	-3.43 [0.07]*	-3.56[0.00]***	H <sub>0</sub> :Reject
ΔLCRTOT	-5.01[0.00]***	-5.12 [0.00]***	-5.00[0.00]***	H <sub>0</sub> :Reject
ΔLCRURB	-5.03[0.00]***	-5.20 [0.00]***	-5.08[0.00]***	H <sub>0</sub> :Reject
ΔLCRRUR	-4.89[0.00]***	-5.02 [0.00]***	-4.95[0.00]***	H <sub>0</sub> :Reject
ΔLCRYGN	-4.75[0.00]***	-4.71 [0.00]***	-4.95[0.00]***	H <sub>0</sub> :Reject
ΔLCRUEMP	-3.18[0.03]**	-3.09 [0.08]*	-3.21[0.00]***	H <sub>0</sub> :Reject
ΔLPOP	-4.36[0.00]***	-4.32 [0.01]***	-2.66[0.01]***	H <sub>0</sub> :Reject
ΔLPOPURB	-3.60 [0.01]***	-3.51 [0.00]***	-3.19[0.00]***	H <sub>0</sub> :Reject
ΔLPOPURR	-4.70[0.00]***	-4.72 [0.00]***	-4.87[0.00]***	H <sub>0</sub> :Reject
ΔLINF	-8.87[0.00]***	-9.57 [0.00]***	-4.35[0.00]***	H <sub>0</sub> :Reject
ΔUNEMP	-3.63[0.01]***	-3.79 [0.03]**	-3.71[0.00]***	H <sub>0</sub> :Reject
ΔLGINI	-4.50[0.00]***	-6.97 [0.00]***	-4.51[0.00]***	H <sub>0</sub> :Reject
ΔLENROL	-4.28[0.00]***	-5.11 [0.00]***	-4.11[0.00]***	H <sub>0</sub> :Reject
ΔGDP	-5.36[0.00]***	-5.41 [0.00]***	-5.40[0.00]***	H <sub>0</sub> :Reject

Notes: Numbers of lags used in ADF regressions were selected using AIC. Probability values of t-statistics are between the brackets. \*\*\*, \*\* and \* denote significantly at 1%, 5% and 10% respectively.

<sup>1</sup>In this and following table for unit root, Δ means first difference of the variables. All the variables are not in levels.

Source: Authors' calculations.

**Table 6.** Johansen-Juselius co-integration test results.

	Eigenvalue	$\lambda_{trace}$				$\lambda_{max}$			
		H <sub>0</sub>	H <sub>1</sub>	$\lambda_{trace}$	5% critic value	H <sub>0</sub>	H <sub>1</sub>	$\lambda_{max}$	5% critic value
Model (4)	0.584035	r=0	r ≤ 1	26.92*	25,87	r=0	r=1	19.29*	19.38
	0.292831	r ≤ 1	r ≤ 2	7.62	12,51	r ≤ 1	r=2	7.62	12.51
Model (5)	0.517934	r=0	r ≤ 1	22.64*	15,49	r=0	r=1	16.05*	14.26
	0.258935	r ≤ 1	r ≤ 2	6.59	3,84	r ≤ 1	r=2	6.59	3.84
Model (6)	0.547232	r=0	r ≤ 1	24.88*	15,49	r=0	r=1	17.43*	14.26
	0.287654	r ≤ 1	r ≤ 2	7.45	3,84	r ≤ 1	r=2	7.45	3.84
Model (7)	0.574532	r=0	r ≤ 1	24.81*	15,49	r=0	r=1	18.61*	14.26
	0.245342	r ≤ 1	r ≤ 2	6.19	3,84	r ≤ 1	r=2	6.19	3.84
Model (8)	0.487,543	r=0	r ≤ 1	21.87*	15,49	r=0	r=1	14.69*	12.24
	0.276545	r ≤ 1	r ≤ 2	7.18	3,84	r ≤ 1	r=2	7.18	3.84
Model (9)	0.586778	r=0	r ≤ 1	25.22*	15,49	r=0	r=1	19.11*	14.26
	0.245654	r ≤ 1	r ≤ 2	6.11	3,84	r ≤ 1	r=2	6.11	3.84
Model (10)	0.523422	r=0	r ≤ 1	23.43*	15,49	r=0	r=1	16.49*	14.26
	0.265434	r ≤ 1	r ≤ 2	6.92	3,84	r ≤ 1	r=2	6.92	3.84

Note: The appropriate length of lag was determined three according to Akaike Criteria in VAR model. Critical values for Trace and maximum likelihood tests were obtained from (Osterwald-Lenum, 1992). (\*) and r respectively shows the significance level of 5% and the number of co-integration vectors.

Source: Authors' calculations.

**Table 7.** Granger causality test results.

Models	Dependent V.	Direction	Independent V.	F statistics	Probability
Model (4)	DLCRECO	←←←←←	DLINF	3.91	0.04**
Model (5)	DLCRJUD	←←←←←	DLAVSAL	4.57	0.02**
Model (6)	DLCRRUR	←←←←←	DLPOPURR	4.41	0.02**
Model (7)	DLCRTOT	←←←←←	DLAVSAL	4.14	0.03**
Model (8)	DLCRUEMP	←←←←←	DLINF	6.78	0.00*
Model (8)	DLCRUEMP	←←←←←	DUNEMP	3.38	0.04**
Model (9)	DLCRURB	←←←←←	DLPOPURB	5.16	0.01*
Model (9)	DLCRURB	←←←←←	DLAVSAL	3.97	0.03**
Model (10)	DLCRYGN	←←←←←	DLAVSAL	3.01	0.06***

Note: \*\*\*, \*\* and \* denote significantly at 1%, 5% and 10% respectively.

Source: Authors' calculations.