Property Crime in the South Caucasus - Panel Data Analysis

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ABSTRACT

The paper aims to determine the various variables affecting property crimes (theft, robbery, burglary) in the South Caucasus (Azerbaijan, Armenia, and Georgia). For this purpose, we used panel data from three countries – registered property crimes from 1997 to 2018. Using the first difference estimator of the GMM, we studied the effect of deterrence, socio-economic, geographical, and other variables on property crime rates. The analysis revealed that past crime and urbanization positively affect property crime, while the clear-up rate and real wage change have negative effects. However, the study does not confirm a statistically significant relationship for other economic variables used in the empirical analysis, which may be explained by the economic development levels of these countries.

Keywords: *property crime, deterrence, urbanization, socio-economic factors, panel data*

INTRODUCTION

The classical theory of crime postulates that criminal action depends on a rational individual's free choice due to evaluating the cost-benefit of an illegal action (Becker, 1968; Ehrlich, 1975). In this calculation, the individual considers the risk of disclosure, the probability of punishment, and its severity. Becker (1968) argued that the increase in the probability of punishment has a more direct influence on the potential criminal than the severity of the punishment.

According to Merton (1938), crime is determined by the gap between the culturally recognized goals in society and the legitimate means to achieve them, which pushes the individual toward illegal actions. Cohen and Felson (1979) consider crime an opportunity. Namely, without crime deterrents, a motivated offender and a suitable target increase the likelihood of committing a crime. From the social disorganization theory's perspective, the crime rate is high in a community/neighborhood where social control mechanisms are weakened. According to various authors, this is caused by cultural-value misunderstanding among community members, a lack of social bonds, social capital, and collective (Shaw & McKay, 1942; Rose & Clear, 1998; Sampson et al., 1999). Moreover, the insufficiency of the abovementioned can be caused by poverty, unemployment, population mobility, ethnic heterogeneity, and many other factors (Shaw & McKay, 1942; Sampson & Groves, 1989; Kubrin & Weitzer, 2003).

The broad interest of scholars in the empirical study of the mentioned theories is apparent. However, relatively less attention has been paid to the former Soviet Union countries. In these countries, the transition from a socialist regime to a democratic system based on market principles has only occurred over the past three decades. Among them are South Caucasus countries that also featured armed conflicts in the first decade of the re-establishment of independence (Nagorno-Karabakh, Abkhazia, South Ossetia, Civil War). These conflicts affected economic transition, justice, and institutional development. As a result of these conditions, these countries have been experiencing a lack of adequate legal means of property protection. At the same time, the institution of the 'thieves-in-law' (organized crime characteristic of post-Soviet states) has gained more and more power (Kukhianidze, 2009; Kupatadze, 2012; Slade, 2013). Therefore, our purpose is to study crime rates in the South Caucasus countries, namely, to empirically examine socio-economic and other factors affecting property crime in Georgia, Armenia, and Azerbaijan.

The classical theory pays enormous attention to crime deterrence, from which the clear-up rate is singled out. According to the theory, if the crime detection likeli-

hood is high, it has a negative effect on the crime rate since, in such circumstances, there is a high probability of arrest for a potential offender (Saridakis & Spengler, 2012; Bun et al., 2019). Therefore, one frequently used explanatory variable in empirical studies determining property crime is the clear-up rate (Buonanno & Montolio, 2008; Han et al., 2013; Engelen et al., 2016).

Some scholars consider inflation to explain the change in the crime rate (Nilsson, 2004; Tang & Lean, 2007; Nunley et al., 2015; Rosenfeld & Levin, 2016; Rosenfeld et al., 2018). High inflation is expected to increase crime rates (Devine et al., 1988). On the one hand, inflation reduces the purchasing power of households. In particular, more nominal financial resources are needed under inflation to maintain the consumption level. Thus, high inflation implies a decrease in living standards. On the other hand, income inequality is anticipated to increase increase (Albanesi, 2007), which may positively affect the crime rate (Soares, 2004).

Among the economic factors affecting the crime rate, the most widely studied is unemployment (Cantor & Land, 1985; Raphael & Winter-Ebmer, 2001; Buonanno, 2003; Edmark, 2005; Öster & Agell, 2007; Andresen, 2012; Altindag, 2012; Phillips & Land, 2012; Speziale, 2014; Recher, 2019). In addition, from the labor market indicators, employee output (wages) is often used (Doyle et al., 1999; Gould et al., 2002; Machin & Meghir, 2004). Some scholars consider that if wages increase at the bottom, a negative effect on crime is expected. On the contrary, if wages increase at the top, it raises inequality among the workers, which can become an incentive for low-paid employees to earn income through illegal means (Machin & Meghir, 2004; Engelen et al., 2016).

Ehrlich (1975) argues that an educated individual has less incentive to commit a crime. Since an individual with low education is anticipated to earn less than the average wage, it is more likely that the latter will engage in illegal income earning. In the case of an educated person, the potential offender's opportunity costs increase, or the punishment imposed on them is relatively expensive (Lochner & Moretti, 2004). The positive relationship between crime and education is empirically supported (Edmark, 2005; Buonanno & Leonida, 2006; Buonanno & Montolio, 2008; Lochner, 2010; Machin et al., 2011; Bennett, 2018; Nordin, 2018).

A lifestyle change is predicted after divorce. Dramatic lifestyle changes are related to crime, so changing an individual's marital status can lead to committing a crime. Some authors have empirically demonstrated a positive relationship between property crime and divorce (Nilsson, 2004; Edmark, 2005; Halicioglu, 2012; Halicioglu et al., 2012).

Examining the relationship between the population's age structure, gender, and crime is of great interest to scholars. It is considered that young men are more likely to engage in criminal activity (Cohen & Land, 1987; Steffensmeier & Harer, 1987; Devine et al., 1988; Levitt, 1998; Levitt, 1999; Buonanno, 2003). Moreover, it is widely supported empirically (Entorf & Spengler, 2000; Rickman & Witt, 2007; Choe, 2008; Buonanno & Montolio, 2008; Lin, 2009; Hooghe et al., 2010; Altindag, 2012; Han et al., 2013; Engelen et al., 2016; Rosenfeld et al., 2018; Brosnan, 2018).

Urban locations, characterized by a high density, are considered contributors to street crime. In urban areas, the object of the crime is more accessible, and the probability of a crime being committed is higher. According to Glaeser and Sacerdote (1999), city size and crime are related in three ways:

- Higher pecuniary returns to crime in urban areas.
- Lower probability of arrest in urban areas.
- Urban areas' attraction (or creation) of crime-prone individuals.

On the other hand, in less urban areas and small towns, the police have much more information about the population and are more familiar with potential criminals. Wilson and Herrnstein (1998) argue that due to the familiarity of the population in smaller cities and less dense settlements, the simultaneous informal community and formal sanctions for the potential offender are expected to have a more powerful deterrent effect. Several papers deal with the positive relationship between urbanization and crime rate (Buonanno & Montolio, 2008; Hooghe et al., 2010; Halicioglu et al., 2012; Speziale, 2014). However, a negative relationship was also found (Engelen et al., 2016).

EMPIRICAL FRAMEWORK

For the empirical study of the determinants of crimes against property, based on the literature reviewed above, we can derive the following econometric model:

$$CR_{it} = a + \beta_1 CR_{it-1} + \beta_k D_{it} + \beta_z E_{it} + \beta_y S_{it} + \beta_x G_{it} + \varepsilon_{it} \quad \textbf{(1)}$$

where

$$\varepsilon_{it} = \eta_i + \upsilon_{it} \quad \textbf{(2)}$$

In equation (1), *CR* - the crime rate is the dependent variable. In addition, the model includes the lagged dependent variable as an explanatory variable since some scholars argue that a criminal past leads an individual to commit crimes in the future (Witt et al., 1999; Saridakis & Spengler, 2012; Frederick et al., 2016). The other independent variables on the right-hand side are deterrence (*D*), economic variables (*E*), social factors (*S*), and geographic/demographic variables (*G*). In both equations, *i* denotes countries, where $i = 1, 2, 3 \ldots I$, and *t* denotes time (year), where $t = 1, 2, 3 \ldots T$. In equation (1), α is an intercept, and β is the slope, presented for each *k*-, *z*-, *y*-, and *x-th* explanatory variables. The last term on the right-hand side of equation (1) is the unobservable random error. In equation (2), is the unobserved time-constant country-specific effect that may be correlated with some independent variables. Under such a condition, the assumption $\mathrm{Cov}(x_{it}; \varepsilon_{it}) = 0$ is violated. Thus, it is necessary to eliminate the issue that is possible by first difference transformation. As a result, we get the following linear dynamic model:

$$\Delta CR_{it} = \delta_1 \Delta CR_{it-1} + \delta_k \Delta D_{it} + \delta_z \Delta E_{it} + \delta_y \Delta S_{it} + \delta_x \Delta G_{it} + \Delta \upsilon_{it} \qquad \textbf{(3)}$$

where υ_{it} is the error term that is correlated with the lagged dependent explanatory variable - Cov (CR_{it-1} ; υ_{it}) ≠ 0 (endogeneity). Because $\Delta CR_{it-1} = CR_{it-1} - CR_{it-2}$ is correlated with $\Delta \upsilon_{it} = \upsilon_{it} - \upsilon_{it-1}$ and CR_{it-1} correlates with . In addition to the lagged dependent variable, endogeneity may be with crime deterrence variables (Reilly & Witt, 1996; Levitt, 1996; Witt et al., 1999; Saridakis & Spengler, 2012; Frederick et al., 2016). However, dealing with the endogeneity problem can be done using the Generalized Method of Moments (GMM). In particular, this is the difference GMM estimator (Arellano & Bond,1991). For the First-differences equation, where there is an endogeneity problem, we use the lags of their origin levels (t-2) as the instruments. Baltagi (2005; 2021) has well summed up the justification of instrumenting the endogenous variable by its lag. Finally, to get a consistent estimate of δ_1, δ_k, δ_z, δ_y and δ_X ($N \to \infty$ with *T* fixed), the first-difference equation is following:

$$\begin{aligned} CR_{it} - CR_{it-1} &= \delta_1 (CR_{it-1} - CR_{it-2}) + \delta_k (D_{it} - D_{it-1}) + \delta_z (E_{it} - E_{it-1}) + \\ &+ \delta_y (S_{it} - S_{it-1}) + \delta_x (G_{it} - G_{it-1}) + (\upsilon_{it} - \upsilon_{it-1}) \end{aligned} \qquad \textbf{(4)}$$

From equation (4), if we take a simple autoregressive model for CR_{i1}, CR_{i2}, CR_{i3} … CR_{it}, first, second, third ... observation, we derive the following:

$$CR_{i3} - CR_{i2} = \delta(CR_{i2} - CR_{i1}) + (\upsilon_{i3} - \upsilon_{i2}); \quad t = 3 \qquad \textbf{(5)}$$

$$CR_{i4} - CR_{i3} = \delta(CR_{i3} - CR_{i2}) + (\upsilon_{i4} - \upsilon_{i3}); \quad t = 4 \qquad \textbf{(6)}$$

$$CR_{i5} - CR_{i4} = \delta(CR_{i4} - CR_{i3}) + (\upsilon_{i5} - \upsilon_{i4}); \quad t = 5 \qquad \textbf{(7)}$$

In this case, CR_{i1} is a valid instrument since it is highly correlated with (CR_{i2} - CR_{i1}) and not correlated with $(\upsilon_{i3} - \upsilon_{i2})$ as long as the are not serially correlated. Like CR_{i1}, CR_{i2} is valid as long as it is highly correlated with (CR_{i3} - CR_{i2}) and has no correlation with $(\upsilon_{i4} - \upsilon_{i3})$, etc.

EMPIRICAL RESULTS

Among property crimes, three main types- robbery, burglary, and theft- and their clear-up rate are discussed. The data source on crime is the annual reports published by the official statistics offices of Georgia, Azerbaijan, and Armenia (https://www.geostat.ge/en ; https://www.armstat.am/en/ ; https://www.stat.gov.az/?lang=en). In the case of Georgia, additionally, the data for the years 1997-2012 were requested from the Ministry of Internal Affairs (https://police.ge/en). Data on the number of prisoners, real wages, divorce rates, and urbanization were also obtained from the mentioned sources. Other demographic variables, such as total population, age, and gender, are obtained from the database prepared by the UN Population Division (https://population.un.org/wpp/). Changes in the consumer prices index and the GDP per capita (at constant prices, PPP) are from the WEO database of the International Monetary Fund (https://www.imf.org/en/data). The employment rate and education level are from the databases of the International Labor Organisation and the UNESCO Institute for Statistics (https://ilostat.ilo.org/; http://uis.unesco.org/).

The data we used covers the period 1997-2018 in the South Caucasus—Armenia, Azerbaijan, and Georgia. Economic, social, and demographic variables are presented, which are expected to be factors in property crime (see Table 1).

Since the data includes crimes registered by the police, imperfect recording is expected to exist (Lin, 2009). This problem is reflected not only in the crime rate but also in the clear-up rate. As a result, this increases the measurement error (Levitt, 1996). However, the actual crime rate is assumed to be proportional to unreported (Ehrlich, 1996). Accordingly, the problem can be alleviated by transforming the variable into the natural logarithm. The logarithmic form of variables reduces the

range between variable values, reducing the impact of crime reporting bias and outliers (Choe, 2008;Saridakis & Spengler, 2012;Frederick et al., 2016). Therefore, our dependent and independent variables (except price changes and real wage growth) will be used in the logarithm.

The models we selected are valid. We utilized Arellano and Bond's one-step first difference estimator, where the original level lag (t-2, t-3, t-4 ... t-n) was used as an instrument for the endogenous variables. To test the validity of the instruments, we used Sargan's *J* statistic. The null hypothesis assumes that the instruments used are valid. Hence, the null hypothesis may not be rejected under the conditions of the valid instruments. The instruments used with 6 out of 8 models are valid. In the case of robbery, all models meet the validity test, and only four are suitable for burglary.

Regarding autocorrelation, we used the Arellano and Bond test. Here, the null hypothesis for the first AR(1) and the second AR(2) - order is based on the absence of autocorrelation. Therefore, the null hypothesis should not be rejected for second-order AR(2) and be rejected for first-order AR(1), respectively. As a result, the absence of first-order autocorrelation is rejected for all types of property crimes, and vice versa for second-order is not rejected (see Table 2).

Our analysis reveals a statistically significant positive relationship ($P < 0.001$) between the current and past crime rates, confirmed in all valid models. A similar result is found with the clear-up rate, which negatively correlates with the property crime rate ($p < 0.001$). Also, there is a statistically significant positive association between urbanization and the crime rate ($P < 0.001$). However, no statistically significant relationship is found between the population proportion of young and middle-aged men and the crime rate (see Table 2).

As for the labor market indicators - in the two models, the negative effect of the real wage is statistically significant at 0.05 and 0.1. On the other hand, there is no statistically significant relationship between employed young men and property crime. In contrast, an increase in the employment rate of men aged 25+ has a positive association ($P < 0.001$). A similar result exists between tertiary education and the aggregated property crime rate ($P < 0.5$).

In contrast to the aggregate crime rate, in some models, a statistically significant negative relationship between the clear-up rate and robbery rate is confirmed only at 0.1. Also, there is no significant relationship between the robbery rate, urbanization, and other variables. There is a statistically significant positive relationship between both crime categories - robbery and burglary and the lagged rate ($P < 0.001$), and the clear-up rate of robbery is associated with a decrease in the crime rate (P

< 0.001). There is no evidence of the effect of urbanization, real wage growth, and employment rate on the robbery and burglary rates (see Table 3 & Table 4).

The share of theft in property crimes is high. The positive association between the theft rate and its lag is confirmed at 0.001. Also, urbanization has a relatively large impact, statistically significant at 0.001. Namely, other things being equal, an increase in urbanization leads to an increase in theft (see Table 5). On the other hand, improving the detection of the mentioned crime category leads to a reduction in crime, confirmed at 0.001.

Finally, we have seen that all models are valid. The magnitude of impact under different types of crime is explained by different independent variables. In some cases, evidence of the influence of theoretically expected variables is not found.

DISCUSSION

The results of our analysis allow us to prove that the property crime (theft, robbery and burglary) rate is determined by its lag. Moreover, our estimates are the range obtained using a similar model by other authors (Witt et al., 1999; Buonanno & Montolio, 2008; Saridakis & Spengler, 2012). Also, the analysis established that the clear-up rate, other things being equal, decreases the property crime rate. Such an effect is more visible in theft and burglary, whose coefficient is between -0.19 and -0.43 and repeats the results of a similar empirical model (Saridakis & Spengler, 2012; Curry et al., 2016). As for other variables, a statistically significant relationship with urbanization is confirmed. Namely, other things being equal, an increase in the share of residents in an urban settlement is associated with an increase in thefts. In this case, urbanization, population age distribution and growth (first difference of GDP per capita) are similar to the results obtained by other authors with a similar empirical model (Howsen & Jarrell, 1987; Buonanno & Montolio, 2008). Like Han et al.(2013), we find no evidence of a statistically significant relationship between labor market indicators and property crime rates. In more detail, the authors examined data from England and Wales (1992-2008) but found no evidence of a labor market effect on property crime. However, similar to our results, the coefficient of the dependent variable lagged in the theft was between 0.60 - 0.68 (Han et al., 2013). In contrast to the latter, our study revealed a significant negative relationship between real wage growth and theft and burglary rates.

CONCLUSION

We studied the socioeconomic factors of property crimes (robbery, burglary, and theft) in South Caucasus countries from 1997-2018. For this, we used Arellano and Bond's one-step first difference estimator. Our analysis confirms that the high crime rate in the previous period and urbanization are positively associated with current crime rates. In addition, the clear-up and the change in real wages have a negative effect on property crime. Evidence for the effects of urbanization and real wage is particularly robust in theft.

Evidence for the effect of urbanization on property crime provides empirical support for both classical and sociological theories of crime. In urbanized areas, there is a greater concentration of property, which increases the opportunity for a potential offender to receive benefits. On the other hand, the probability of arrest is relatively low because, in such areas, it is relatively tricky for the police to find a circle of suspects (Glaeser & Sacerdote, 1999). According to classical theory, this increases the net benefit of the potential offender. Furthermore, in sociological theory, the possibility of social (informal) control decreases in urban areas since there are fewer social ties (Sampson & Groves, 1989).

We do not have enough evidence for the effect of other socio-economic indicators on property crime. The economic development of the South Caucasus countries can explain this. All three countries are developing economies. Some scholars argue that development brings social conditions with a specific and different relationship to crime. As a result, property crime will increase, and violent crime will decrease (Shichor, 1990; Arthur & Marenin, 1995). Suppose the development benefits do not improve the whole population's well-being and are distributed only to high-income groups. Under such circumstances, poor people are more likely to commit property crimes since the opportunity to earn more income through illegal activities increases. Therefore, it is expected that there is a non-linear relationship between development and property crime. Empirical proof of this requires, on the one hand, an individual-level (micro) study and, on the other hand, a larger sample and time series.

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REFERENCES

Albanesi, S. (2007). Inflation and inequality. *Journal of Monetary Economics*, *54*(4), 1088–1114. https://doi.org/10.1016/j.jmoneco.2006.02.009

Altindag, D. T. (2012). Crime and unemployment: Evidence from Europe. *International Review of Law and Economics*, *32*(1), 145–157. https://doi.org/10.1016/j.irle.2011.10.003

Andresen, M. A. (2012). Unemployment and crime: A neighborhood level panel data approach. *Social Science Research*, *41*(6), 1615–1628. https://doi.org/10.1016/j.ssresearch.2012.07.003

Anna Nilsson. (2004). Income inequality and crime: The case of Sweden #. *Research Papers in Economics*.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, *58*(2), 277. https://doi.org/10.2307/2297968

Arthur, J. A., & Marenin, O. (1995). Explaining crime in developing countries: The need for a case study approach. *Crime, Law and Social Change*, *23*(3), 191–214. https://doi.org/10.1007/bf01301636

Baltagi, B. H. (2005). *Econometric Analysis of Panel Data*. John Wiley & Sons Inc.

Baltagi, B. H. (2021). *Econometrics*. Springer Publishing.

Becker, G. S. (1968). Crime and Punishment: An Economic Approach. *Journal of Political Economy*, *76*(2), 169–217. https://doi.org/10.1086/259394

Bennett, P. (2018). The heterogeneous effects of education on crime: Evidence from Danish administrative twin data. *Labour Economics*, *52*, 160–177. https://doi.org/10.1016/j.labeco.2018.02.002

Brosnan, S. (2018). *The Socioeconomic Determinants of Crime in Ireland from 2003-2012*. https://www.esr.ie/article/view/910/185

Bun, M. J. G., Kelaher, R., Sarafidis, V., & Weatherburn, D. (2019). Crime, deterrence and punishment revisited. *Empirical Economics*, *59*(5), 2303–2333.

https://doi.org/10.1007/s00181-019-01758-6

Buonanno, P., & Leonida, L. (2006). Education and crime: evidence from Italian regions. *Applied Economics Letters*, *13*(11), 709–713. https://doi.org/10.1080/13504850500407376

Buonanno, P., & Montolio, D. (2008). Identifying the socio-economic and demographic determinants of crime across Spanish provinces. *International Review of Law and Economics*, *28*(2), 89–97. https://doi.org/10.1016/j.irle.2008.02.005

Cantor, D., & Land, K. C. (1985). Unemployment and Crime Rates in the Post-World War II United States: A Theoretical and Empirical Analysis. *American Sociological Review*, *50*(3), 317. https://doi.org/10.2307/2095542

Choe, J. (2008). Income inequality and crime in the United States. *Economics Letters*, *101*(1), 31–33. https://doi.org/10.1016/j.econlet.2008.03.025

Cohen, L. E., & Felson, M. (1979). Social Change and Crime Rate Trends: A Routine Activity Approach. *American Sociological Review*, *44*(4), 588. https://doi.org/10.2307/2094589

Cohen, L. E., & Land, K. C. (1987). Age Structure and Crime: Symmetry Versus Asymmetry and the Projection of Crime Rates Through the 1990s. *American Sociological Review*, *52*(2), 170. https://doi.org/10.2307/2095446

Curry, P. A., Sen, A., & Orlov, G. (2016). Crime, apprehension and clearance rates: Panel data evidence from Canadian provinces. *Canadian Journal of Economics/Revue Canadienne D'économique*, *49*(2), 481–514. https://doi.org/10.1111/caje.12204

Devine, J. A., Sheley, J. F., & Smith, M. D. (1988). Macroeconomic and Social-Control Policy Influences on Crime Rate Changes, 1948-1985. *American Sociological Review*, *53*(3), 407. https://doi.org/10.2307/2095648

Doyle, J. M., Ahmed, E., & Horn, R. N. (1999). The Effects of Labor Markets and Income Inequality on Crime: Evidence from Panel Data. *Southern Economic Journal*, *65*(4), 717. https://doi.org/10.2307/1061272

Edmark, K. (2005). Unemployment and Crime: Is There a Connection? *Scandinavian Journal of Economics*, *107*(2), 353–373. https://doi.org/10.1111/j.1467-9442.2005.00412.x

Ehrlich, I. (1996). Crime, Punishment, and the Market for Offenses. *Journal of Economic Perspectives*, *10*(1), 43–67. https://doi.org/10.1257/jep.10.1.43

Engelen, P. J., Lander, M. W., & van Essen, M. (2016). What determines crime rates? An empirical test of integrated economic and sociological theories of criminal behavior. *The Social Science Journal*, *53*(2), 247–262. https://doi.org/10.1016/j.soscij.2015.09.001

Entorf, H., & Spengler, H. (2000). Socioeconomic and demographic factors of crime in Germany. *International Review of Law and Economics*, *20*(1), 75–106. https://doi.org/10.1016/s0144-8188(00)00022-3

Frederick, S., Jozefowicz, J., & Nelson, Z. (2016). A dynamic panel data study of the unemployment-crime relationship: the case of Pennsylvania. *Economics Bulletin*, *36*(3), 1497–1507. http://www.accessecon.com/Pubs/EB/2016/Volume36/EB-16-V36-I3-P148.pdf

Glaeser, E., & Sacerdote, B. (1999). Why is There More Crime in Cities? *Journal of Political Economy*, *107*(S6), S225–S258. https://doi.org/10.1086/250109

Gould, E. D., Weinberg, B. A., & Mustard, D. B. (2002). Crime Rates and Local Labor Market Opportunities in the United States: 1979–1997. *Review of Economics and Statistics*, *84*(1), 45–61. https://doi.org/10.1162/003465302317331919

Halicioglu, F. (2012). Temporal causality and the dynamics of crime in Turkey. *International Journal of Social Economics*, *39*(9), 704–720. https://doi.org/10.1108/03068291211245727

Halicioglu, F., Andrés, A. R., & Yamamura, E. (2012). Modeling crime in Japan. *Economic Modelling*, *29*(5), 1640–1645. https://doi.org/10.1016/j.econmod.2012.05.026

Han, L., Bandyopadhyay, S., & Bhattacharya, S. (2013). Determinants of violent and property crimes in England and Wales: a panel data analysis. *Applied Economics*, *45*(34), 4820–4830. https://doi.org/10.1080/00036846.2013.806782

Hooghe, M., Vanhoutte, B., Hardyns, W., & Bircan, T. (2010). Unemployment, Inequality, Poverty and Crime: Spatial Distribution Patterns of Criminal Acts in Belgium, 2001-06. *British Journal of Criminology*, *51*(1), 1–20. https://doi.org/10.1093/bjc/azq067

Howsen, R. M., & Jarrell, S. B. (1987). Some Determinants of Property Crime: Economic Factors Influence Criminal Behavior But Cannot Completely Explain the Syndrome. *American Journal of Economics and Sociology*, *46*(4), 445–457. https://doi.org/10.1111/j.1536-7150.1987.tb01992.x

Isaac Ehrlich. (1975). On the Relation between Education and Crime. *NBER Chapters*, 313–338. https://ideas.repec.org/h/nbr/nberch/3702.html

Kubrin, C. E., & Weitzer, R. (2003). New Directions in Social Disorganization Theory. *Journal of Research in Crime and Delinquency*, *40*(4), 374–402. https://doi.org/10.1177/0022427803256238

Kukhianidze, A. (2009). Corruption and organized crime in Georgia before and after the 'Rose Revolution.' *Central Asian Survey*, *28*(2), 215–234. https://doi.org/10.1080/02634930903043709

Kupatadze, A. (2012). *Organized Crime, Political Transitions and State Formation in Post-Soviet Eurasia*. Springer.

Levitt, S. (1998). Juvenile Crime and Punishment. *Journal of Political Economy*, *106*(6), 1156–1185. https://doi.org/10.1086/250043

Levitt, S. D. (1996). The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation. *The Quarterly Journal of Economics*, *111*(2), 319–351. https://doi.org/10.2307/2946681

Levitt, S. D. (1999). The limited role of changing age structure in explaining aggregate crime rates*. *Criminology*, *37*(3), 581–598. https://doi.org/10.1111/j.1745-9125.1999.tb00497.x

Lin, M. J. (2009). More police, less crime: Evidence from US state data. *International Review of Law and Economics*, *29*(2), 73–80. https://doi.org/10.1016/j.irle.2008.12.003

Lochner, L. (2010). Education and Crime. *International Encyclopedia of Education*, 239–244. https://doi.org/10.1016/b978-0-08-044894-7.01229-x

Lochner, L., & Moretti, E. (2004). The Effect of Education on Crime: Evidence from Prison Inmates, Arrests, and Self-Reports. *American Economic Review*, *94*(1), 155–189. https://doi.org/10.1257/000282804322970751

Lyon, F. E., Shaw, C. R., & McKay, H. D. (1943). Juvenile Delinquency and Urban Areas. *Journal of Criminal Law and Criminology (1931-1951)*, *34*(1), 39. https://doi.org/10.2307/1137187

Machin, S., & Meghir, C. (2004). Crime and Economic Incentives. *The Journal of Human Resources*, *39*(4), 958. https://doi.org/10.2307/3559034

Machin, S., Marie, O., & Vujić, S. (2011). The Crime Reducing Effect of Education. *The Economic Journal*, *121*(552), 463–484. https://doi.org/10.1111/j.1468-0297.2011.02430.x

Merton, R. K. (1938). Social Structure and Anomie. *American Sociological Review*, *3*(5), 672. https://doi.org/10.2307/2084686

Nordin, M. (2018). Does Eligibility for Tertiary Education Affect Crime Rates? Quasi-Experimental Evidence. *Journal of Quantitative Criminology*, *34*(3), 805–829. https://doi.org/10.1007/s10940-017-9355-8

Nunley, J. M., Stern, M. L., Seals, R. A., & Zietz, J. (2015). The impact of inflation on property crime. *Contemporary Economic Policy*, *34*(3), 483–499. https://doi.org/10.1111/coep.12156

Öster, A., & Agell, J. (2007). Crime and Unemployment in Turbulent Times. *Journal of the European Economic Association*, *5*(4), 752–775. https://doi.org/10.1162/jeea.2007.5.4.752

Paolo Buonanno. (2003). The Socioeconomic Determinants of Crime. A Review of the Literature. *Research Papers in Economics*. http://dems.unimib.it/repec/pdf/mibwpaper63.pdf

Phillips, J., & Land, K. C. (2012). The link between unemployment and crime rate fluctuations: An analysis at the county, state, and national levels. *Social Science Research*, *41*(3), 681–694. https://doi.org/10.1016/j.ssresearch.2012.01.001

Raphael, S., & Winter-Ebmer, R. (2001). Identifying the Effect of Unemployment on Crime. *The Journal of Law and Economics*, *44*(1), 259–283. https://doi.org/10.1086/320275

Recher, V. (2019). Unemployment and property crime: evidence from Croatia. *Crime, Law and Social Change*, *73*(3), 357–376. https://doi.org/10.1007/s10611-019-09865-2

Reilly, B., & Witt, R. (1996). Crime, deterrence and unemployment in england and wales: an empirical analysis. *Bulletin of Economic Research*, *48*(2), 137–159. https://doi.org/10.1111/j.1467-8586.1996.tb00629.x

Rickman, N., & Witt, R. (2007). The Determinants of Employee Crime in the UK. *Economica*, *74*(293), 161–175. https://doi.org/10.1111/j.1468-0335.2006.00530.x

Rose, D. R., & Clear, T. R. (1998). Incarceration, social capital, and crime: implications for social disorganization theory*. *Criminology*, *36*(3), 441–480. https://doi.org/10.1111/j.1745-9125.1998.tb01255.x

Rosenfeld, R. M., & Levin, A. (2016). Acquisitive Crime and Inflation in the United States: 1960–2012. *Journal of Quantitative Criminology*, *32*(3), 427–447. https://doi.org/10.1007/s10940-016-9279-8

Rosenfeld, R., Vogel, M., & McCuddy, T. (2018). Crime and Inflation in U. S. Cities. *Journal of Quantitative Criminology*, *35*(1), 195–210. https://doi.org/10.1007/s10940-018-9377-x

Sampson, R. J., & Groves, W. B. (1989). Community Structure and Crime: Testing Social-Disorganization Theory. *American Journal of Sociology*, *94*(4), 774–802. https://doi.org/10.1086/229068

Sampson, R. J., Morenoff, J. D., & Earls, F. (1999). Beyond Social Capital: Spatial Dynamics of Collective Efficacy for Children. *American Sociological Review*, *64*(5), 633. https://doi.org/10.2307/2657367

Saridakis, G., & Spengler, H. (2012). Crime, deterrence and unemployment in Greece: A panel data approach. *The Social Science Journal*, *49*(2), 167–174. https://doi.org/10.1016/j.soscij.2011.08.005

Shichor, D. (1990). Crime Patterns and Socioeconomic Development: A Cross-National Analysis. *Criminal Justice Review*, *15*(1), 64–78. https://doi.org/10.1177/073401689001500107

Slade, G. (2013). *Reorganizing Crime: Mafia and Anti-Mafia in Post-Soviet Georgia*. https://doi.org/10.1093/acprof:oso/9780199674640.001.0001

Soares, R. R. (2004). Development, crime and punishment: accounting for the international differences in crime rates. *Journal of Development Economics*, *73*(1), 155–184. https://doi.org/10.1016/j.jdeveco.2002.12.001

Speziale, N. (2014). Does unemployment increase crime? Evidence from Italian provinces. *Applied Economics Letters*, *21*(15), 1083–1089. https://doi.org/10.1080/13504851.2014.909568

Steffensmeier, D. J., & Harer, M. D. (1987). Is the Crime Rate Really Falling? An "Aging" U.S. Population and its Impact on the Nation's Crime Rate, 1980-1984. *Journal of Research in Crime and Delinquency*, *24*(1), 23–48. https://doi.org/10.1177/0022427887024001003

Tang, C. F., & Lean, H. H. (2007). Will Inflation Increase Crime Rate? New Evidence from Bounds and Modified Wald Tests. *Global Crime*, *8*(4), 311–323. https://doi.org/10.1080/17440570701739694

Wilson, J. Q., & Herrnstein, R. J. (1998). *Crime & Human Nature: The Definitive Study of the Causes of Crime* (Illustrated). Free Press.

Witt, R. (1999). Crime and economic activity. A panel data approach. *British Journal of Criminology*, *39*(3), 391–400. https://doi.org/10.1093/bjc/39.3.391

Table 1: Descriptive statistics

Variables	Definition	Armenia					Azerbaijan					Georgia				
		N	*M*	*SD*	*Min*	*Max*	*N*	*M*	*SD*	*Min*	*Max*	*N*	*M*	*SD*	*Min*	*Max*
CR	Property crime (per 100 000 inhabitants)	22	136.1	43.68	87.1	249.5	22	46.77	19.52	23.87	83.8	22	325.1	177.4	119.3	841
CRr	Robbery (per 100 000 inhabitants)	22	2.981	0.924	1.547	4.942	22	1.964	0.481	1.212	3.098	22	19.6	14.15	6.98	55.77
CRb	Burglary (per 100 000 inhabitants)	22	5.965	1.895	3.612	8.674	22	2.658	0.681	1.718	4.136	22	20.77	16.29	7.157	71.04
CRth	Theft (per 100 000 inhabitants)	22	127.2	43.02	78.52	239.8	22	42.14	19.43	19.58	79.79	22	284.7	158.4	94.13	714.1
CR_c	Clear-up rate	22	0.26	0.143	0.058	0.577	22	0.913	0.077	0.714	1.035	22	0.453	0.215	0.164	0.789
CRr_c	Clear-up rate	22	0.537	0.179	0.106	0.933	22	0.849	0.172	0.412	1.132	22	0.574	0.128	0.354	0.738
CRb_c	Robbery clear-up rate	22	0.379	0.152	0.151	0.735	22	0.963	0.148	0.625	1.201	22	0.607	0.177	0.245	0.792
CRth_c	Burglary clear-up rate	22	0.247	0.144	0.055	0.573	22	0.916	0.074	0.733	1.072	22	0.442	0.228	0.141	0.805
P	Prisoners (per 100 000 inhabitants)	22	146.2	42.57	77.14	229	22	242.6	28.04	208.6	315.5	22	314.1	162.3	155.4	644.9
Wr	Real wage growth, %	22	9.164	8.417	-2.2	25.8	22	13.31	11.74	-0.61	52.5	22	11.9	11.66	-1.96	36.06
GDPpc	GDP per capita (PPP,int. dollar)	22	8200	3080	3379	12715	22	9967	4728	3179	14876	22	8819	3262	4269	14257
CPI	Consumer Price Index growth (%)	22	4.146	3.614	-1.41	14.05	22	5.274	6.36	-8.53	20.78	22	5.684	4.268	-0.94	19.14
ErYM	Young men employment rate	22	29.58	1.952	24.34	32.25	22	34.39	3.485	29.14	41.42	22	32.37	2.389	28.63	36.86
Er25M	Adult men employment rate (25+)	22	64.67	2.735	60.35	70.28	22	75.18	1.376	72.77	77.67	22	72.25	2.256	67.73	75.31
15_44rP	Share of males aged 15-44 in the population	22	45.45	0.587	44.48	46.38	22	49.98	1.28	47.67	51.55	22	44.58	1.652	41.24	46.06
15_24rP	Share of males aged 15-24 in the population	22	7.902	0.755	6.487	8.863	22	9.316	0.89	7.594	10.44	22	8.219	0.719	6.634	8.822
25_34rP	Share of males aged 25-34 in the population	22	6.614	0.978	5.486	8.244	22	9.316	0.89	7.594	10.44	22	7.617	0.188	7.313	7.856
35_44rP	Share of males aged 35-44 in the population	22	5.958	0.787	5.031	7.221	22	7.112	0.476	6.484	7.776	22	7.208	0.258	6.9	7.653
U	Urbanisation rate	22	63.84	0.732	63.08	65.5	22	52.45	0.79	51.1	53.24	22	56.58	1.101	54.34	58.66
E	Share of the persons with tertiary education in the population	22	38.94	6.636	28.78	48.67	22	20.06	2.434	18.03	25.91	22	39.53	8.166	25.28	57.26
D	Registered divorce (per 100 000 inhabitants)	22	89.52	32.63	37.13	149.5	22	99.14	27.43	62.41	148.8	22	123.1	90.5	39.4	276.3

Table 2: Property crime rate (theft, robbery, burglary)

Independent variables	Dependent Variable - Property crime							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Property crime $_{t-1}$	.679***	.663***	.636***	.663***	.764***	.651***	.669***	.721***
Clear-up rate	-.346***	-.187***	-.384***	-.432***	-.283***	-.336***	-.333***	-.23***
Prisoners	.0561	.109	-.00548	-.126*	.00651	-.0962	-.104	.0608
Wage growth	-.00359		-.00572*	-.00727**	-.00492	-.00192	_	-.0028
GDP per capita	_	.0512	_	_	_	_	_	_
Inflation	.00254	_	.00144	.00303	.00513	.00591	.00548	.00554
Employment 14-24	-.461	-.443	_	.131	_	_	-.1	_
Employment 25+	2.84***	_	_	_	_	_	_	_
Education	.344*	.527***	.36**		.523**	_	_	.495***
Divorce	-.0239	_	-.206***	-.211***	-.0479	_	_	-.0399
Urbanisation	_	_	8.44***	9.29***		5.88***	5.99***	
Share of males aged 15-24	_	_	_	_	-.0425	-.0317	_	_
Share of males aged 25-34	_	_	_	_	-.652	_	_	_
Share of males aged 35-44	_	_	_	_	_	_	_	.195
m1	*0.0023*	*0.0024*	*0.0008*	*0.0014*	*0.0009*	*0.0030*	*0.0039*	*0.0015*
m2	*0.7985*	*0.5806*	*0.3551*	*0.2963*	*0.4521*	*0.2923*	*0.3404*	*0.4868*
J	*0.2455*	*0.0619*	*0.3311*	*0.1761*	*0.1316*	*0.0118*	*0.0105*	*0.0806*
N	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*

*Note: * Statistically significant at the 0.1; ** statistically significant at the 0.05; *** Statistically significant at the 0.001. m1 and m2 of the first and second order autocorrelation test; J Sargan Test.*

Table 3: Robbery rate

Independent variables	Dependent Variable - robbery							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Robbery rate $_{t-1}$ (ln)	.66***	.678***	.684***	.712***	.557***	.798***	.94***	.573***
Robbery clear-up rate	-.174	-.174*	-.175*	-.165	-.226*	-.191*	-.169	-.16*
Prisoners	-.084	.194*	-.136	-.199*	-.0023	-.252**	-.306**	-.0738
Wage growth	.00668		.00559	.00487	.00424	.00639		.00852*
GDP per capita	-.456	.111						
Inflation	.00227		.00276	.00265	-.000111	.00183	.00224	
Employment 14-24	.00227	-.367		-.198			-.136	
Employment 25+	1.47							
Education	.232	.647***	.212		.586*			
Divorce	-.182		-.248**	-.209*	-.207*			
Urbanisation			3.36	3.32		2.01	2.17	
Share of males aged 15-24					.847	.556		
Share of males aged 25-34					-.419			
Share of males aged 35-44								-.711
m1	*0.0009*	*0.0036*	*0.0008*	*0.0007*	*0.0010*	*0.0010*	*0.0010*	*0.0010*
m2	*0.9870*	*0.5774*	*0.9756*	*0.8759*	*0.8990*	*0.8544*	*0.9531*	*0.9583*
J	*0.4700*	*0.2589*	*0.4738*	*0.4121*	*0.4964*	*0.3691*	*0.4646*	*0.3271*
N	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*

*Note: * Statistically significant at the 0.1; ** statistically significant at the 0.05; *** Statistically significant at the 0.001. m1 and m2 of the first and second order autocorrelation test; J Sargan Test.*

Table 4: Burglary rate

Independent variables	Dependent Variable - burglary							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Burglary rate $_{t-1}$ (ln)	.441***	.687***	.4929***	.4688***	.346***	.451***	.464***	.403***
Burglary clear-up rate	-.504***	-.169*	-.6162***	-.6174***	-.498***	-.703***	-.551***	-.528***
Prisoners	.0534	.131	-.07427	-.1211	.145	-.153	-.11	.0112
Wage growth	.00133		-.0008299	-.001269	.0005	-.00148		.00226
GDP per capita		.109						
Inflation	.0102		.01153*	.01144*	.00787	.0105	.0137*	.0125*
Employment 14-24	-1.06**	-.35		-.6664			-.847*	
Employment 25+	.657							
Education	.456*	.54**	.2573		.596**			.24
Divorce	-.119		-.1897**	-.1448*	-.116			-.225***
Urbanisation			4.171	3.56		3.31	.568	
Share of males aged 15-24					1.53***	.925**		
Share of males aged 25-34					.926			
Share of males aged 35-44								-1.19**
m1	*0.0258*	*0.0024*	*0.0155*	*0.0146*	*0.0254*	*0.0100*	*0.0124*	*0.0202*
m2	*0.5800*	*0.4023*	*0.6403*	*0.6512*	*0.7635*	*0.3093*	*0.8336*	*0.9703*
J	*0.0794*	*0.1955*	*0.0782*	*0.0626*	*0.0370*	*0.0450*	*0.0406*	*0.0387*
N	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*

*Note: * Statistically significant at the 0.1; ** statistically significant at the 0.05; *** Statistically significant at the 0.001. m1 and m2 of the first and second order autocorrelation test; J Sargan Test.*

Table 5: Theft rate

Independent variables	Dependent Variable - theft							
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Theft rate $_{t-1}$ (ln)	.695***	.658***	.642***	.661***	.782***	.628***	.665***	.738***
Theft clear-up rate	-.346***	-.186***	-.382***	-.432***	-.287***	-.344***	-.342***	-.227***
Prisoners	.0559	.101	-.0025	-.115	.00102	-.0706	-.0911	.0678
Wage growth	-.00445		-.0067**	-.00827***	-.00591	-.00273		-.00356
GDP per capita		.0481						
Inflation	.00242		.000795	.00235	.0057	.00556	.00497	.00593
Employment 14-24	-.435	-.432		.18			-.046	
Employment 25+	3.09***							
Education	.301	.517***	.33*		.501**			.486**
Divorce	-.0093		-.199***	-.211***	-.0423			-.0231
Urbanisation			9.11***	10***		6.72***	6.9***	
Share of males aged 15-24					-.113	-.125		
Share of males aged 25-34					-.769			
Share of males aged 35-44								.286
m1	*0.0016*	*0.0024*	*0.0005*	*0.0009*	*0.0008*	*0.0022*	*0.0029*	*0.0012*
m2	*0.7206*	*0.5967*	*0.3171*	*0.3032*	*0.4074*	*0.3059*	*0.3643*	*0.4272*
J	*0.2923*	*0.0522*	*0.3619*	*0.2349*	*0.1389*	*0.0119*	*0.0142*	*0.0878*
N	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*

*Note: * Statistically significant at the 0.1; ** statistically significant at the 0.05; *** Statistically significant at the 0.001. m1 and m2 of the first and second order autocorrelation test; J Sargan Test.*

Appendix 1: Detailed description of models

In our data set, the time series exceeds the individuals, and multicollinearity exists (T > N). Therefore, after the variance inflation factors (VIF) test (VIF ≥ 3 ; R2 ≥ 60), we use the explanatory variables characterised by collinearity separately in different models to minimise the problem. All equations are as follows:

Model 1: There are used incarceration rate (P), real wage growth (Wr), the employment rate of men aged 15-24 (ErYM), the employment rate of men aged 25+ (Er25+M), change in the consumer price index (CPI), the share of the persons with tertiary education in the population (E) and the registered divorce (D).

$$\Delta lnCRit = \delta 1 \Delta lnCRit{-}1 + \delta 2 \Delta lnCR{-}Cit + \delta 3 \Delta lnPit + \delta 4 \Delta Writ + \delta 5 \Delta lnErYMit + \delta_6 \Delta lnE_r 25M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (1)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_r 25M_{it} + \delta_7 \Delta lnCPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (2)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_r 25M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (3)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_r 25M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (4)$$

Model 2: There are used the prisoners (P), real GDP per capita (GDPpc), the employment rate of men aged 15-24 (ErYM) and the share of the persons with tertiary education in the population (E).

$$\Delta lnCR_{it} = \delta_1 \Delta lnCR_{it-1} + \delta_2 \Delta lnCR_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnGDPpc_{it} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_{it} + \Delta v_{it} \quad (5)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnGDPpc_{it} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_{it} + \Delta v_{it} \quad (6)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnGDPpc_{it} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_{it} + \Delta v_{it} \quad (7)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnGDPpc_{it} + \delta_5 \Delta lnE_r YM_{it} + \delta_6 \Delta lnE_{it} + \Delta v_{it} \quad (8)$$

Model 3: There are used the prisoners (P), real wage growth (Wr), Urbanization rate (U), change in the consumer price index (CPI), the share of the persons with tertiary education in the population (E) and registered divorce (D).

$$\Delta lnCRit = \delta 1 \Delta lnCRit{-}1 + \delta 2 \Delta lnCR{-}Cit + \delta 3 \Delta lnPit + \delta 4 \Delta Writ + \delta 5 \Delta lnUit + \delta 6 \Delta CPIit + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (9)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnU_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (10)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnU_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (11)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnU_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (12)$$

Model 4: There are used prisoners (P), real wage growth (Wr), Urbanization rate (U), change in the consumer price index (CPI), registered divorce (D) and employment rate of men aged 15-24 (ErYM).

$$\Delta lnCRit = \delta 1 \Delta lnCRit{-}1 + \delta 2 \Delta lnCR{-}Cit + \delta 3 \Delta lnPit + \delta 4 \Delta Writ + \delta 5 \Delta lnUit + \delta 6 \Delta CPIit + \delta_7 \Delta lnD_{it} + \delta_8 \Delta lnE_rYM_{it} + \Delta v_{it} \quad (13)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnU_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnD_{it} + \delta_8 \Delta lnE_rYM_{it} + \Delta v_{it} \quad (14)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnU_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnD_{it} + \delta_8 \Delta lnE_rYM_{it} + \Delta v_{it} \quad (15)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnU_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnD_{it} + \delta_8 \Delta lnE_rYM_{it} + \Delta v_{it} \quad (16)$$

Model 5: There are used the prisoners (P), real wage growth (Wr), the share of men aged 15-24 in the population (Pr15_24M), the share of men aged 25-34 in the population (Pr25_34M), changes in the consumer prices index (CPI), the share of the persons with tertiary education in the population (E) and registered divorce (D).

$$\Delta lnCRit = \delta 1 \Delta lnCRit{-}1 + \delta 2 \Delta lnCR{-}Cit + \delta 3 \Delta lnPit + \delta 4 \Delta Writ + \delta 5 \Delta lnPr15\_24Mit + \delta_6 \Delta lnP_r25\_34M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (17)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r15\_24M_{it} + \delta_6 \Delta lnP_r25\_34M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (18)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 15\_24M_{it} + \delta_6 \Delta lnP_r 25\_34M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (19)$$

$$\Delta lnCRthit = \delta 1 \Delta lnCRthit - 1 + \delta 2 \Delta lnCRth - Cit + \delta 3 \Delta lnPit + \delta 4 \Delta Writ + \delta 5 \Delta lnPr 15\_24Mit + \delta_6 \Delta lnP_r 25\_34M_{it} + \delta_7 \Delta CPI_{it} + \delta_8 \Delta lnE_{it} + \delta_9 \Delta lnD_{it} + \Delta v_{it} \quad (20)$$

Model 6: There are used the prisoners (P), real wage growth (Wr), the share of males aged 15-24 in the population (Pr15_24M), the change in the consumer price index (CPI) and Urbanization rate (U).

$$\Delta lnCR_{it} = \delta_1 \Delta lnCR_{it-1} + \delta_2 \Delta lnCR_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 15\_24M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnU_{it} + \Delta v_{it} \quad (21)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 15\_24M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnU_{it} + \Delta v_{it} \quad (22)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 15\_24M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnU_{it} + \Delta v_{it} \quad (23)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 15\_24M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnU_{it} + \Delta v_{it} \quad (24)$$

Model 7: There are used the prisoners (P), Urbanization rate (U), the change in the consumer prices index (CPI) and the employment rate of men aged 15-24 years (ErYM).

$$\Delta lnCR_{it} = \delta_1 \Delta lnCR_{it-1} + \delta_2 \Delta lnCR_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnU_{it} + \delta_5 \Delta CPI_{it} + \delta_6 \Delta lnE_r YM_{it} + \Delta v_{it} \quad (25)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnU_{it} + \delta_5 \Delta CPI_{it} + \delta_6 \Delta lnE_r YM_{it} + \Delta v_{it} \quad (26)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnU_{it} + \delta_5 \Delta CPI_{it} + \delta_6 \Delta lnE_r YM_{it} + \Delta v_{it} \quad (27)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta lnU_{it} + \delta_5 \Delta CPI_{it} + \delta_6 \Delta lnE_r YM_{it} + \Delta v_{it} \quad (28)$$

Model 8: There are used the prisoners (P), real wage growth (Wr), the share of men aged 35-44 in the population (Pr35_44M), the change in the consumer price index (CPI), the share of the persons with tertiary education in the population (E) and the registered divorce (D).

$$\Delta lnCR_{it} = \delta_1 \Delta lnCR_{it-1} + \delta_2 \Delta lnCR_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 35\_44M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (29)$$

$$\Delta lnCRr_{it} = \delta_1 \Delta lnCRr_{it-1} + \delta_2 \Delta lnCRr_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 35\_44M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (30)$$

$$\Delta lnCRb_{it} = \delta_1 \Delta lnCRb_{it-1} + \delta_2 \Delta lnCRb_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 35\_44M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (31)$$

$$\Delta lnCRth_{it} = \delta_1 \Delta lnCRth_{it-1} + \delta_2 \Delta lnCRth_{-Cit} + \delta_3 \Delta lnP_{it} + \delta_4 \Delta W_{rit} + \delta_5 \Delta lnP_r 35\_44M_{it} + \delta_6 \Delta CPI_{it} + \delta_7 \Delta lnE_{it} + \delta_8 \Delta lnD_{it} + \Delta v_{it} \quad (32)$$

To analyse, we utilised Arellano and Bond's one-step first difference estimator. The original level lag (t-2, t-3, t-4 ... t-n) was used as an instrument for the endogenous variables. Furthermore, we tested the instrument validity by Sargan's J statistic. The null hypothesis assumes that the instruments used are valid. Hence, the null hypothesis may not be rejected (P> 0.05) under the conditions of the valid instruments.

Regarding to the autocorrelation, we used the Arellano and Bond test. Here, the null hypothesis for the first AR(1) and the second AR(2) - order is based on the absence of autocorrelation. Therefore, the null hypothesis should not be rejected (P> 0.05) for second-order AR(2) and be rejected (P< 0.05) for firstorder AR(1), respectively. Consequently, if the conditions of both mentioned tests were met, we considered the model valid.