ASSESSMENT OF THE IMPACT OF PERCEIVED CORRUPTION ON ECONOMIC GROWTH USING THE GLS MODEL

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ABSTRACT

Researchers not only dissent on what effect corruption has on economic growth but also whether this effect holds in different institutional contexts. Some economists argue that corruption can stimulate economic growth in environments with poor governance and ineffective institutions (such as those in the Western Balkans region), while others suggest otherwise. This paper aims to investigate the relationship between perceived corruption and GDP per capita change in ten European countries from 2012 to 2021. Our goal is to examine whether non-EU Western Balkans countries, characterised by ineffective governance and underdeveloped institutions, are more or less sensitive to corruption compared to more developed European countries. To obtain robust estimates, we employ a feasible generalised least squares estimation method (GLS). Besides showing a negative effect on the full sample, our analysis confirms different intensities of corruption impact on economic growth under the two governance regimes. The research suggests that the negative effect of corruption is stronger in countries with developed institutions (EU countries). We find that the impact of corruption on economic growth in such countries amounts to up to 1.94 percent drop in GDP per capita after a one-unit rise in corruption level, while the one in non-EU WB countries stands at a maximum of 0.75 percent decrease. Compared to earlier findings, ours are characterised by the focus on Western Balkans countries, the inclusion of more recent data and a more comprehensive pre-estimation analysis.

1. INTRODUCTION

Corruption is widely acknowledged as a phenomenon that significantly negatively impacts societies. It undermines crucial social goals such as non-discrimination, transparency, equality and poverty reduction. While sociologists and legal experts condemn corruption as a wholly negative force that should be eradicated, some economists take a different perspective, moving beyond a purely moralistic approach, as noted by Nye (1967) and Leys (1965). They argue that corruption can sometimes have a beneficial effect when governance is poor and institutions are ineffective. In this paper, we consider institutions as a "system of social factors that are exogenous to each individual whose behavior they influence… and consist of rules, norms, beliefs, and organizations… that enable, guide, and motivate (individuals) to follow specific behavior" (Gräbner & Ghorbani, 2019). In cases when institutions are ineffective, bribery or "greasing the wheels", some think, may help to overcome obstacles created by inefficient bureaucracy (Meon & Sekkat, 2005). On the other hand, numerous economic researchers find evidence of negative impact of corruption on economic growth, including Mauro (1995), Brunetti and Weder (1998) and Mo (2001). Even the findings from the World Economic Forum go on to say that corruption causes a loss in gross domestic product (GDP) of $2.6 trillion or 5% on a global scale (World Economic Journal, 2024). Furthermore, some researchers, including Agale-Kolgo (2018), argue that corruption has neither a negative nor positive influence on economic growth.

Our goal is to explore what can be inferred about the effect of corruption on economic growth from the empirical evidence taking into account both less and more institutionally-developed countries. We draw inspiration from the work of Aidt, Dutta & Sena (2008), Hodge et al. (2011), and Gründler and Potrafke (2019) that examined the impact of corruption on economic growth within two different governance frameworks: 1) advanced governance with high-performance institutions, and 2) poor governance with underdeveloped institutions. However, these studies produced conflicting results: while the first two found that the economic growth in countries with more advanced institutions is more susceptible to the rise in corruption, the third study discovered the opposite. One of the motivations of our study is to see which of these two findings is more consistent with the more recent empirical data.

Our paper aims to find out how corruption is correlated with economic growth in a sample of ten European countries in a ten-year period (2012-2021). The sample consists of two groups of countries. The first group includes the Western Balkans countries that are not EU members and are in the process of joining the

EU, while the second group includes neighboring countries that have fulfilled the conditions to become EU members. Compared to similar studies, our goal is to see if focusing our sample specifically on non-EU Western Balkan countries, as well as more recent data, produces any difference compared to the conclusions based on the full sample.

Our paper is also characteristic as it includes a number of pre-estimation tests that help us determine robust feasible generalised least squares (GLS) as an appropriate estimation method. As it will be made clear shortly, our results imply the existence of a negative effect of perceived corruption on economic growth, albeit less pronounced in non-EU Western Balkans countries.

The remainder of this paper is structured as follows: Section 2 reviews the existing literature on corruption and its impact on economic growth. Section 3 outlines our model, variables and estimation method. Section 4 presents the estimates from various model specifications and their interpretations. Finally, Section 5 highlights the key conclusions of the paper.

2. LITERATURE REVIEW

For more than half of a century, numerous studies explored the relationship between corruption and economic growth. Some researchers analysed that relation in the context of institutional quality and governance efficiency. Some of them concluded that many countries suffer from "red tape", which includes the extensive, unnecessary administrative burden and oversized bureaucracy. In such conditions, officers are demotivated and demonstrate suboptimal personal productivity (Jovanović et al, 2022; Bach, Løkke Møller & Villadsen, 2021; Bellé & Cantarelli, 2017; Bozeman, 1993; Brewer & Walker, 2010; Buchanan, 1975; Cooke, Brant & Woods, 2019). Their inefficient work may result in a slowdown of transactions between the public and private sectors as well as an increase in costs in terms of time and efforts needed.

Regarding the potential impacts of an extensive and rigid bureaucracy on economic growth Huntington (1968), however, maintained that "in terms of economic growth, the only thing worse than a society with a rigid, overcentralized, dishonest bureaucracy is one with a rigid, overcentralized, honest bureaucracy". This suggests that corruption can help in overcoming bureaucratic constraints in some ways. For instance, bribes could provide officers an incentive to speed up the process, thus reducing unnecessary waiting time (Lui, 1985; Leys, 1965). Summers (1977) argues that corruption "greases the wheels" by stimulating public officials to operate efficiently, thus reducing the bureaucracy burden as an obstacle to economic development. Beck and Maher (1986) and Lien (1986) came to the similar conclusions.

Furthermore, it may be that the more complicated regulation, the more chances that some formal and not necessarily substantive requirement is not fulfilled. Assistance of officers compensated by the bribe in fulfilling all requirements could provide a significant advantage to the client compared to others who could not rely on such informal help (Huntington, 1968). Leys (1965) and Bayley (1966) argue that corruption may help overcome the widespread problem of public administration – non-competitive salaries of its employees compared to the private sector which results in officers' lower competencies. The possibility of earning an extra income in the form of a bribe could attract more capable professionals to public administration, thus upgrading its efficiency.

Contrary to those who emphasised the positive effects of corruption on governance and economic growth, many researchers argued the opposite. Mauro (1995) pointed out the negative impact of corruption on economic development due to constraints it creates for investment. According to Mauro's analysis, improving the corruption perceptions index for one standard deviation may increase GDP per capita from 0.2 to 0.8 percentage points, depending on the model specification applied.

Mauro's findings were confirmed by Mo (2001) according to whom a one-point increase in corruption results in economic growth slowdown by 0.545 percentage points. Moreover, the study by Gründler and Potrafke (2019), which included data for 175 countries in the period between 2012 and 2018, found more significant negative impact of corruption on GDP in the long run. Specifically, an increase of the relevant corruption index of one standard deviation was shown to lead to the reduction of GDP per capita by a tremendous 17%.

Corruption's negative impact on economic growth was confirmed by numerous studies based on panel data. These include the ones from Aidt, Dutta & Sena (2008), AlQudah, Zouaoui & AboElsoud (2020), Brunetti and Weder (1998), Chang and Hao (2017), Cieślik and Goczek (2018), d'Agostino, Dunne & Pieroni (2016), Hodge et al. (2011), Huang (2016), Johnson, LaFountain & Yamarik (2011), Méon and Sekkat (2005), Swaleheen (2011) and Tsanana Chapsa & Katrakilidis (2016).

The restrictive influence of corruption on economic growth is explained by its constraining effect on investment (Mauro, 1995), inflation of prices of goods, services and works (Nwabuzor, 2005), increase in unnecessary public expenditures that reduce economic activity and efficiency of public spending, lowering of quality of public services, and increase in shadow economy that causes unfair distribution of tax burden (Spyromitros & Panagiotidis, 2022).

The majority of researchers on corruption consider it as a "sanding the wheels" issue that limits economic growth (Rose-Ackerman, 1978; Shleifer & Vishny, 1993; Mauro, 1995). Tanzi and Davoodi (1998) even stressed that corruption favors public investment over private one and thus disrupts efficient and productive use of capital in an economy.

In practice, corruption is believed to establish new forms of exchanges between companies and the public sector compared to the regular ones (Cuervo-Cazurra, 2015). A prerequisite for corruption is that the costs of illegal transactions are lower than those of legal ones (Polinsky & Shavell, 1992). Transaction costs of corrupt practice refer to enforcement and detection (Von Lampe, 2008). Enforcement costs are generated based on risks of failure to obtain needed goods or services as well as the risk of no protection in such cases while detection costs are related to the risk of being discovered by third parties (Lambsdorff & Teksoz, 2004).

Williamson (2008) recognised three major factors that determine transaction costs: 1) the uncertainty under which the transaction takes place, 2) the frequency of the transaction, and 3) the level of transaction investment. In cases where regulation is bureaucratic and with a high administrative burden that generates additional costs, stakeholders from both the private and public sectors will have a motive to improve efficiency by cutting them (Lui, 1985). For example, in public procurement complex procedures and demanding "paperwork" would create significant transaction costs for potential bidders (Čudanov, Jovanović & Jaško, 2018). In addition to that, a high level of institutional uncertainty, which means that institutions are ineffective in law enforcement with a low probability that those involved in corruption will be detected and sanctioned decreases detection costs and result in a more favorable environment for corruption (Troisi & Alfano, 2023). In such circumstances corruption may be perceived as an instrument that enables operation at lower transaction costs, thus increasing the efficiency and economic of transactions between public sector and private companies. Furthermore, reduced transaction costs are expected to have a positive impact on economic growth.

Although some empirical studies confirmed the positive impact of corruption on economic growth, the authors pointed out that this kind of relation is valid only under certain conditions. Mendez and Sepulveda (2006) stated that corruption had a small but positive impact on economic growth in countries with high levels of civil liberties and political rights. In the research of Hodge et al. (2011), which included 81 countries in the period 1984-2005, the findings were that corruption may have a positive (or less negative) impact on economic growth but only in countries with low-quality public administration and unnecessarily high levels of regulation. Ang (2020) detected a specific form of corruption in China marked as "access money" and viewed it as a significant positive factor during the period of fast economic growth in China. Using a panel of 65 countries over 25 years, Trabelsi (2023) concluded that corruption can have either a positive or negative effect on growth depending on whether its level passes certain thresholds.

However, some studies, such as the Agale-Kolgo (2018), based on a fairly large sample of 101 developing countries in the period 2009 – 2015, failed to detect either a negative or positive influence of corruption on economic growth. In the next section, we will present the model and estimation method that we plan to use to estimate the effect of corruption on economic growth. It would be of vital importance to show that our model possesses qualities that enable it to produce reliable estimates of relevant parameters.

3. MATERIALS AND METHODS

The starting point of our analysis is the augmented version of the model of economic growth developed by Solow (1956) and expanded by authors such as Mankiw, Romer & Weil (1992) and Barro (1989) to include variables such as human capital and government consumption. To obtain a more complete estimate of the human capital on economic growth, we include both the commonly used education variable and the less frequently used health variable. This produces the following model:

$$\ln Y_t = \beta_0 + \beta_1 \ln INV_t + \beta_2 LAB_t + \beta_3 GOV_t + \beta_4 EDU_t + \beta_5 HEA_t + \mu_t$$

In the given model, *Y* indicates the GDP per capita of a certain country (in constant 2015 prices). *INV* indicates gross investments in fixed capital in constant prices, *LAB* refers to labour force participation (among people older than 15), while the variable *GOV* indicates the share of public spending on final consumption as a percentage of GDP. Finally, the variable *EDU* represents the level of public spending on education (measured as a share of GDP), and *HEA* includes national life expectancy at birth for each country. μ represents a random error, while t is the time index.

Following AlQudah Zouaoui & AboElsoud (2020, p. 43), we modify the aforementioned model by adding the corruption variable. We also add a time dummy to account for the effects of 2012 and 2020 recessions:

$$\ln Y_t = \beta_0 + \beta_1 \ln INV_t + \beta_2 LAB_t + \beta_3 EDU_t + \beta_4 HEA_t + \beta_5 GOV_t + \beta_6 COR_t + \beta_7 DUMMY_t + \mu_t$$

To measure corruption (COR), we utilised the values of Transparency International's corruption perceptions index (CPI) for the given countries and periods. COR is the normalised corruption perceptions index (CPI) for a specific country. In this model, normalisation was achieved using the following equation: (1-CPI/100)*100. This kind of normalisation was achieved so that higher values of the index indicate higher levels of corruption. In some model specifications we estimated, the COR variable is based on values of the World Bank's control of corruption index (CC). Even though both indices are based on perceived corruption, CC is more directed toward the so-called bureaucratic corruption of unelected officials while CPI comprises more sources related to higher-level political corruption (Hamilton & Hammer, 2018, pp. 14-5). Evaluating the effect of both of these measures may help us obtain more robust estimates of perceived corruption on economic growth.

We employed a model with a log value of GDP per capita in constant prices as our dependent variable. We did this in order to estimate the effects on the change in GDP per capita, which is the specified goal of our research. To get accurate estimates of the effects of corruption, we controlled for the aforementioned variables commonly viewed as determinants for economic growth, which include proxies for investment, labour force participation, education, health and public spending, as well as a time dummy. To obtain estimates that are not susceptible to heteroskedasticity and correlation, we employed a robust feasible generalised least squares estimation method (GLS). We also analysed a couple of different model specifications to see whether or how estimation results differ among them. In one of them, we inspected the robustness of our model by substituting the investment variable with another control variable – private capital stock.

Most of the data was retrieved from the World Bank database of global development indicators (World Bank, 2024a): GDP per capita (constant 2015 US$); gross fixed capital formation (constant 2015 US$); labour force participation rate (% of total population ages 15+); life expectancy at birth (years); final consumption expenditure (% of GDP), while data on education (mean years of schooling) were retrieved from the United Nations Development Programme database (UNDP, 2024). International Monetary Fund investment and capital stock database helped us obtain data on capital stock (IMF, 2024). Data sources on corruption variables, however, included Transparency International (2024) for CPI and the World Bank database of global governance indicators (World Bank, 2024b) for CC.

In the study of the impact of corruption on economic growth, we use a sample of ten European countries and observed the period from 2012 to 2021. Besides the analysis of the full sample, we examine and compare the influence of corruption on economic growth in the two groups of countries that are included in our sample. The first group consists of the Western Balkan non-EU countries (WB) that are in the process of transformation and accession to the EU. One of the major goals of the process is the upgrading of governance and development of institutions to achieve EU standards, which brings to the conclusion that their governance is still poor and institutions weak. This group includes the following countries: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia and Serbia.

The second group consists of WB neighboring countries that have already achieved EU standards in terms of quality of governance and strength of their institutions, thus fulfilling conditions to become EU Member States. This group includes Slovenia, Croatia, Hungary, Romania and Bulgaria. In the paper, we will investigate if there is a difference in the intensity of corruption influence on GDP growth between the two groups.

4. RESULTS AND DISCUSSIONS

First, we present some basic descriptive statistics of the data. Table 1 shows data on mean, maximum and minimum values for each variable comprising the model above, along with their standard deviations. In the end, the table also shows the results of the LM Jarque-Bera Normality Test for the regression having GDP per capita in constant prices as a dependent variable and other listed variables as independent ones.[1]

1 The table includes descriptive statistics of variables in their non-logarithmic form. Expectedly, similar resolution of Jarque-Bera Test follows if we include natural logarithm versions of any variable in the regression to assess the normality of standard error distribution (results available upon request).

Table 1. Basic descriptive statistics and LM Jarque-Bera Normality Test

Variable	Mean	St. dev.	Minimum	Maximum	Observations
GDP per cap. overall	9253.61	5381.505	3736.34	24744.84	N=100
($USD, 2015) between		5555.81	4191.65	22081.09	n=10
within		948.48	7104.99	11927.36	T=10
Investment overall	12.4 billion	14 billion	676 million	53.6 billion	N=100
($USD, 2015) between		14.4 billion	1.1 billion	45.8 billion	n=10
within		2.56 billion	3.73 billion	21.2 billion	T=10
Labour force overall	46.96	5.79	32.85	56.91	N=100
(% of 15+ pop.) between		5.29	36.29	53.68	n=10
within		2.84	39.87	53.81	T=10
Education overall	11.16	1.03	7.89	12.8	N=100
(avg school ys) between		1	9.54	12.62	n=10
within		0.38	9.51	12.15	T=10
Health overall	76.47	2.03	71.51	81.53	N=100
(life expectancy) between		1.97	74.31	80.88	n=10
within		0.75	73.67	77.65	T=10
Public spending overall	18.01	3.3	10.84	25.03	N=100
(% of GDP) between		3.25	11.36	22.66	n=10
within		1.16	15.86	21.03	T=10
Corruption level overall	56	7.03	39	69	N=100
(inverse CPI) between		6.93	40.5	64.8	n=10
within		2.41	49.4	61.4	T=10
LM Jarque-Bera Normality Test	LM Test statistic = 1.06679		p-value = 0.58661		N=100

Source: Authors' calculations using Stata 14 software

As shown in Table 1, values of each variable are provided as either overall, between or within-group measurements. This provides us with a basic overview of data characteristics and variability. Worth noting are the results for the investment variable. The higher values for the overall and between standard deviations compared to the mean suggest high variation between countries and, given the lack of negative and zero values of investment, a likely departure from normal distribution. To correct for this result, we include a natural logarithm form of investment in the following model estimations.[2] Also important is the result of the Jarque-Bera Test, which points to the non-rejection of the null hypothesis. This suggests that errors in the linear panel model with the GDP per capita as a dependent variable are normally distributed, thus enabling a reliable statistical

2 Standard deviations of the log form of Investment show much smaller values compared to the mean (22.67. mean and 1.105 overall standard deviation). Full descriptive statistics for the log form of investment variable are available upon request.

inference. Another important step is to perform a correlation analysis to check for possible multicollinearity issues that may affect the quality of the estimates' features. Table 2 shows the Pearson correlation matrix for the variables included in the model.

Table 2. Pearson correlation matrix

	GDP per capita	Invest-ment	Labour force	Educa-tion	Health	Public spending	Corrup-tion level	Time dummy
GDP per capita	1							
Investment	0.3065	1						
Labour force	0.5948	0.4923	1					
Education	0.7456	0.2477	0.7356	1				
Health	0.5501	-0.3064	0.1713	0.3340	1			
Public spending	0.4079	0.0037	-0.2610	0.2157	0.0334	1		
Corruption	-0.8844	-0.2314	-0.4133	-0.6538	-0.4673	-0.4619	1	
Time dummy	-0.0286	-0.0018	-0.0538	-0.0417	-0.0942	0.1514	0.0250	1

Source: Authors' calculations using Stata 14 software

Although these correlation findings may hint at what relationship may exist between the variables included in the model, regression analysis is required to reveal how different variables actually affect GDP per capita. Correlation analysis may, however, help in exploring the possible multicollinearity among independent variables by showing values higher than the absolute value of 0.7. In Table 2, such a value can be found in the case of the correlation between the labour force and education. Variance inflation factor analysis (reported in Table 3, on the left side) indicates that further scrutiny is required as the value for labour force surpasses 5.

Table 3. Variance inflation factor analysis: full model (left), model w/o labour force (middle), and model w/o education (right)

	VIF (full model)	1/VIF (full model)	VIF (model w/o labour force)	1/VIF (model w/o labour force)
Investment	2.01	0.496679	1.52	0.658510
Labour force	5.61	0.178190	-	-
Education	4.52	0.221248	1.82	0.550876
Health	1.89	0.528023	1.89	0.528023
Public spending	2.74	0.365434	1.50	0.667308
Corruption level	3.07	0.326001	3.00	0.333248
Time dummy	1.05	0.950268	1.04	0.962833
Mean VIF	2.99		1.79	

Source: Authors' calculations using Stata 14 software

However, when labour force (right side of Table 3) is excluded from the model, variance inflation factor analysis produces more satisfying values of below 5.[3] Even though caution is needed, dropping variables based on VIF alone might not be warranted given that neither variable shows values above 10, which would be an almost certain indicator of multicollinearity (Menard, 2001, p. 76-7).

Before proceeding to the estimation of the model parameters, we should see if our data suffer from heteroskedasticity or some form of residual correlation. To check the former, we conducted two heteroskedasticity tests. The first is the so-called Breusch-Pagan/Cook-Weisberg test for heteroskedasticity which makes use of residuals from the pooled linear model regression. The second one, on the other hand, is a Wald-type test for groupwise heteroskedasticity that is based on the residuals from the unmodified generalised least squares regression. Both regressions were conducted on a model with natural logarithm versions of both GDP per capita and investment. The results from these tests are written in Table 4.

Table 4. Heteroskedasticity tests results

Test	χ^2 test statistic	p-value	Outcome
Breusch-Pagan/Cook-Weisberg	9.91	0.0016	Rejection of null
Modified Wald	49.81	0.0000	Rejection of null

Source: Authors' calculations using Stata 14 software

Both Breusch-Pagan/Cook-Weisberg and the Wald-type test unambiguously suggest that residuals suffer from heteroskedasticity. That these results point to heteroskedasticity in the model presents one of the main motivations for resorting to heteroskedasticity-robust generalised least squares (GLS) estimation. Another reason to make use of the GLS estimation method lies in the evidence of serial correlation of residuals, obtained from the Wooldridge test for autocorrelation in panel data (shown in Table 5).[4]

3 VIF of labour force achieves values below 5 if education variable is omitted from the model. Moreover, the model without education but with labour force possesses lower Akaike and Schwarz information criteria values than the model with education but without labour force (parameter estimates do not show significant differences). The model with both variables, however, shows even lower information criteria values (all results are available upon request). Due to this outcome, as well as the need for inclusion of proxy variable for human capital and the robust estimates of its strong effect expressed later in our article, we choose to keep education variable as a vital part of our model.

4 Neither heteroskedasticity nor any type of correlation dissapear if we omitt either education or labour force variable from the model (results available upon request).

Table 5. First-order serial correlation test results

Test	F test statistic	p-value	Outcome
Wooldridge	23.472	0.0009	Rejection of null

Source: Authors' calculations using Stata 14 software

The F test statistic indicated that residuals possess a structure of the first-order AR process. Further tests reveal that the AR coefficient varies among groups. This can be inferred from the different rho values for the subsamples of EU and non-EU countries.[5] The advantage of the GLS estimation method is that it can accommodate for such a group-specific serial correlation. Finally, we need to address the issue of cross-sectional correlation. Pesaran tests taken for individual variables separately yield results presented in Table 6.

Table 6. Pesaran pre-estimation cross-dependence test results

Variable	CD test statistic	p-value	Outcome
lnGDP per capita	20.217	0.000	Rejection of null
lnInvestment	16.028	0.000	Rejection of null
Labour force	15.473	0.000	Rejection of null
Education	19.703	0.000	Rejection of null
Health	15.676	0.000	Rejection of null
Public spending	7.573	0.000	Rejection of null
Corruption level	0.614	0.539	Non-rejection of null
Time dummy	21.213	0.000	Rejection of null

Source: Authors' calculations using Stata 14 software

These results clearly show that only the corruption level does not exhibit any sort of cross-sectional correlation. All other variables are, however, characterised by cross-sectional dependence at a level of 1-percent significance. Other types of estimation, such as those involving fixed and random effects, do not solve the cross-dependence issue, as is revealed by Pesaran-type post-estimation tests.[6] The results of these tests are provided in Table 7.

Table 7. Pesaran post-estimation cross-dependence test results

Model specification	CD test statistic	p-value	Outcome
Fixed effects	2.310	0.0209	Rejection of null at 5 percent
Random effects	4.325	0.0000	Rejection of null at 1 percent

Source: Authors' calculations using Stata 14 software

5 These rho values amount to around 0.994 for the EU and around 0.985 for the non-EU countries subsample, respectively. There are minor differences depending on whether the labour force is included in the model or not. The detailed results and procedure information of the subsample rho estimation are available upon request.

6 More on this type of testing can be found in Pesaran (2004).

The outcomes of all the previously conducted tests both offer the justification of the GLS estimation procedure and point to modifications that need to be taken into account to get the most reliable parameter estimates. These are provided in Table 8 and include modifications for both heteroskedasticity and (both serial and cross-sectional) correlation.

Table 8. Generalised least squares static model estimation with standard errors in parentheses (corrected for heteroskedasticity and cross-sectional and serial correlation)

Variable	1	2	3	4	5	6
Constant	1.012*** (0.106)	3.2845*** (0.1513)	0.1047 (0.1306)	0.5401*** (0.1038)	0.0941 (0.4029)	-0.0367 (0.1588)
lnInvestment	0.2134*** (0.0031)	0.1753*** (0.0045)	0.1995*** (0.0035)	0.1693*** (0.0014)	-	0.1793*** (0.003)
Education	0.2931*** (0.0054)	0.154*** (0.0069)	0.1621*** (0.003)	0.1696*** (0.0018)	0.2324*** (0.0232)	0.1505*** (0.0054)
Public spending	0.0407*** (0.0009)	0.037*** (0.0019)	0.0414*** (0.0011)	0.0428*** (0.0006)	0.0378*** (0.0031)	0.0422*** (0.0012)
CPI-based corruption	-0.0186*** (0.0006)	-0.0112*** (0.0011)	-0.0088*** (0.0005)	-0.0152*** (0.0003)	-0.0131*** (0.0013)	-
Time dummy	-	-0.0646*** (0.0041)	-0.0614*** (0.0035)	-0.0592*** (0.0019)	0.0235** (0.0104)	-0.0587*** (0.0021)
Health	-	-	0.0301*** (0.0011)	0.0313*** (0.0009)	0.0673*** (0.0067)	0.0297*** (0.0018)
Labour force	-	-	-	0.0088*** (0.0002)	0.0082*** (0.0017)	0.0063*** (0.0008)
lnCapital Stock	-	-	-	-	0.1633*** (0.0072)	-
Control of Corruption	-	-	-	-	-	0.2617*** (0.1856)
Wald χ^2 test:	6155.8***	19248***	16154***	27111***	6628.58***	17041.7***

*, **, and *** indicate 10, 5, and 1 percent significance, respectively.

Source: Authors' calculations using Stata 14 software

Table 8 yields parameter estimates for six model specifications. The first specification presents the simplest model that includes investment (log form), education, public spending and CPI-based corruption as explanatory variables. The second specification is extended with the inclusion of a time dummy, while the third one also adds health as a variable to capture wider aspects of human capital. The fourth specification extends the model even further, including labour force among the other explanatory variables. The robustness of the corruption effect is checked with the last two specifications: while the fifth one assesses the robustness of investment as a control by substituting it with capital stock (in the log from as well), the sixth one utilises the aforementioned CC variable to see whether a change in corruption variable may bring about different conclusions.

The majority of variables exhibit significant effects at 1 percent. The strongest effect is seen in cases of investment and education. For investment, estimates show that a hundred percent increase in real gross capital formation may lead to a 16.93 to 17.93 percent increase in real GDP per capita if we take into account specifications 4 and 6, respectively. The estimates go even higher in other specifications, reaching up to 21.34 percent in the first specification. In the case of education, the first specification shows that an additional year of schooling for an average person can increase national GDP per capita by as much as 29.31 percent in the first model. The more realistic estimates, however, point to values between 15 and 17 percent (as is the case in all other specifications).

Other effects tend to be somewhat more similar among specifications. All but one specifications show the time effect of 2012 and 2020 recessions to be markedly strong, lowering national GDP per capita by 5.87 to 6.46 percent. The only exception is the fifth specification which shows an unexpectedly positive value. This result is almost certainly due to the omission of the period after 2019 from the sample due to the lack of more recent IMF data on private capital stock. This means that the time dummy failed to cover the 2020 recession, the strongest one in the observed period. On the other hand, a one-year increase in average life expectancy is estimated to bring about between 2.97 (as for the sixth specification) and 3.13 (based on the fourth specification) percent rise in national GDP per capita, with the 6.73 percent effect in the fifth specification sticking out as an outlier. Public spending is also shown to bear positive result for real GDP growth per capita, ranging from a 3.7 to 4.28 percent increase in GDP per capita as a result of a 1 percent increase in the share of government expenditure in GDP. Furthermore, the specifications that contain it reveal that a one percent rise in labour force participation makes national GDP per capita around 0.6 to 0.9 percent higher.

Finally, we should take account of the crucial corruption level estimates. The results from all model specifications are clear: a rise in CPI-based corruption (or, at least, the perception of it) leads to a decrease in real GDP per capita. More concretely, this effect is estimated to lie between -1.9 (in the first specification) and -0.9 percent decrease (in the third specification) following a one-point boost in corruption level. Even though seemingly smaller than the other ones in absolute terms, this effect is nonetheless highly statistically significant and can especially diminish the level of national income if the negative trend of rise in corruption endures. Both the coefficient sign and statistical significance remain the same regardless of the variations among different model specifications.

What is more, the effect of perceived corruption is estimated to be even stronger if we include the aforementioned CC-based variable. The model estimation shows that a one-point rise in this indicator may raise national per capita income by around a quarter. As this indicator tends to be more focused on various lower-level types of corruption, this result may suggest that these practices may even be more detrimental to economic growth than the ones involving political or other types of higher-level corruption.

It would also be worth investigating how stable are the GLS regression estimates among our subsamples. As can be seen from the previous section, the sample is constructed to include an equal number of EU member states and countries that still do not belong to the EU even though they possess candidate country status. If, along these lines, we divide the full sample into two, we get two subsamples with 5 groups and 10 periods each. Applying the heteroskedasticity and correlation-corrected GLS estimation procedure to these two subsamples yields parameter estimates presented in Table 9 (for the non-EU subsample) and Table 10 (for the EU subsample).

Table 9. Generalised least squares static model estimation with standard errors in parentheses: non-EU WB countries subsample

Variable	1	2	3	4	5	6
Constant	6.7477*** (0.4353)	7*** (0.4043)	7.8872*** (0.7344)	7.8552*** (0.5264)	6.0102*** (0.8285)	7.5103*** (0.541)
lnInvestment	0.0515*** (0.0153)	0.0249* (0.0142)	0.0262 (0.017)	0.0007 (0.0125)	-	0.0019 (0.0129)
Education	0.1343*** (0.01)	0.1209*** (0.0104)	0.1335*** (0.008)	0.0934*** (0.0111)	0.1301*** (0.0128)	0.092*** (0.0111)
Public spending	-0.0092** (0.0042)	0.0101*** (0.0033)	0.008** (0.0034)	0.017*** (0.0033)	0.0248*** (0.0039)	0.0177*** (0.0033)
CPI-based corruption	-0.0075*** (0.0019)	-0.0059*** (0.0015)	-0.0046** (0.0018)	-0.0029** (0.0015)	-0.0024 (0.002)	-
Time dummy	-	-0.045*** (0.0068)	-0.0521*** (0.0144)	-0.0511*** (0.0077)	-0.0246** (0.0112)	-0.0522*** (0.0069)
Health	-	-	-0.0145** (0.006)	-0.0123*** (0.004)	0.0057 (0.0104)	-0.0104 (0.0038)
Labour force	-	-	-	0.0136*** (0.0018)	0.0099*** (0.0024)	0.0142*** (0.0018)
lnCapital Stock	-	-	-	-	0.0154* (0.0091)	-
Control of Corruption	-	-	-	-	-	0.0517 (0.032)
Wald χ^2 test:	316.59***	250.64***	575.13***	794.73***	638.66***	850.79***

*, **, and *** indicate 10, 5, and 1 percent significance, respectively.

Source: Authors' calculations using Stata 14 software

Table 10. Generalised least squares static model estimation with standard errors in parentheses: EU countries subsample

Variable	1	2	3	4	5	6
Constant	2.6537*** (0.9371)	3.8106*** (0.889)	1.0879 (0.8319)	1.992* (1.0755)	0.986 (0.6564)	-0.0679 (0.699)
lnInvestment	0.0724** (0.0353)	0.0693** (0.0332)	0.072** (0.0324)	0.0666 (0.045)	-	0.151*** (0.0115)
Education	0.4714*** (0.0288)	0.3828*** (0.0276)	0.3296*** (0.0475)	0.2664*** (0.0382)	0.189*** (0.0303)	0.1368*** (0.032)
Public spending	013*** (0.0031)	0.0202*** (0.0028)	0.0235*** (0.0031)	0.0402*** (0.0037)	0.02*** (0.0032)	0.0372*** (0.0039)
CPI-based corruption	-0.0143*** (0.0026)	-0.0176*** (0.0025)	-0.0157** (0.0024)	-0.0194*** (0.0021)	-0.0046*** (0.001)	-
Time dummy	-	-0.056*** (0.0193)	-0.0398** (0.0199)	-0.0645*** (0.0195)	0.0468*** (0.0099)	-0.046*** (0.013)
Health	-	-	0.0405*** (0.0082)	0.0292*** (0.0085)	0.0672*** (0.0088)	0.0364*** (0.0087)
Labour force	-	-	-	0.0138*** (0.0027)	0.0182*** (0.0026)	0.0158*** (0.0032)
lnCapital Stock	-	-	-	-	0.0015 (0.0216)	-
Control of Corruption	-	-	-	-	-	0.4452*** (0.0412)
Wald χ^2 test:	2291.47***	792.28***	3234.32***	3945.83***	17650.7***	3663.21***

*, **, and *** indicate 10, 5, and 1 percent significance, respectively.

Source: Authors' calculations using Stata 14 software

These results reveal some differences among parameters depending on the subsample. Thus, the statistically significant positive and strong effect of investment remains in the case of EU countries, at least in the vast majority of model specifications,[7] while this significance and strength fully erode when we turn to non-EU WB countries. The latter results may have to do with the influence of certain factors that restrain the pro-growth activity of capital formation in the sampled non-EU countries. On the other hand, the values for the labour force and education remain positive and statistically significant. The value of the latter, however, rises up to 50 percent as we drop various control variables from the model and restrict ourselves to the sample of EU countries. This estimate, entailing a rise in GDP per capita by around a half as a result of an additional year of schooling for an average person, makes up the largest effect of any variable in our analysis so far.

7 In the case of specification with the labour force, the EU countries' subsample estimation produces a relatively strong effect with a p-value that is marginally higher than 0.1 (more details are available upon request).

Yet, the most surprising finding concerns the effect of health on real GDP per capita. While the parameter estimate almost equals the full sample one in the case of EU member states, it turns out to be both negative and statistically significant for non-EU WB countries. This result would imply that a one-year increase in the average life span may lead to a 1 to 1.5 percent drop in real GDP per capita in sampled countries that do not belong to the EU. One possible explanation of this finding may entail that increased life expectancy in non-EU WB countries from our sample brings some economic costs (including those for pensions, welfare and healthcare) that offset any benefits from the prolonged workforce participation. To assess this hypothesis, a further examination of age-dependent productivity and costs in these countries is required. In addition, the estimates for the effects of health, along with the ones for investment, may be affected by relatively small sizes of both subsamples (50 observations each).

The estimated effects of variables such as public spending and the time dummy, however, mostly possess size, direction and statistical significance that approach the ones for the full sample and do not differ between subsamples. The only important difference concerns the smaller (but still negative) effect of time dummy in non-EU WB countries and an unexpectedly positive effect of this variable among EU countries in the fifth specification. As already indicated, this outcome is highly obviously related to the omission of the 2020 recession from the sample.

The effect of corruption level, as our treatment variable, turns out to be negative in all our subsample specifications. The main difference lies in the finding that the negative effect of CPI-based corruption seems to be stronger in EU countries (ranging between 0.46 and 1.94 percent drop in GDP per capita after a one unit rise in corruption) than in their non-EU counterparts (where it stands at around 0.24 to 0.75 percent decrease). Worth noting is the variation in the effect of CC-based corruption in the non-EU WB subsample compared to the EU one. Whereas the effect among the EU countries ends up being quite strong and resoundingly significant, the effect among the non-EU countries, even though expectedly positive, happens to be much smaller in size (around 5.17 percent) and virtually on the threshold of 10 percent statistical significance (p-value of 0.0106).[8]

However, regardless of the model specification and the subsample analysed, the effect of corruption level remains negative, while its control tends to

8 Of course, these results are very likely affected by the smaller sizes of subsamples. This is especially the case with the fifth specificaiton where, due to omission of two years, the subsample includes only 40 observations. This may explain the lack of statistical significance of negative estimated CPI-based corruption effect among non-EU WB countries.

significantly increase economic growth. Given that the same holds for the full sample, we may conclude that our empirical results confirm the "sanding-the-wheels" hypothesis about the effect of corruption on economic growth. This result generally confirms the findings from other empirical studies that show the negative effects of corruption on economic growth. If we take a closer look at our subsample analysis, we may, however, conclude that our results are more aligned with the results from studies such as those from Mendez and Sepulveda (2006), Aidt, Dutta & Sena (2008), or Hodge and others (2011) which suggest that, while generally negative, the effect of corruption on growth is less negative (or even nonexistent) in the case of countries with lower quality of governance, which is generally the case with the non-EU WB countries from our sample.[9] This is much to the contrary of the findings from the research of Gründler and Potrafke (2019) which points out that better governance tempers the strength of negative corruption effects on economic growth while the lower quality of governance makes it more pronounced.

5. CONCLUSIONS

Our research confirms that corruption generally exhibits negative effects on economic growth, theoretically supporting the "sanding-the-wheels" hypothesis. It also shows that corruption has a more severe negative impact on economic growth in countries with established institutions and effective governance, such as those in the EU. In contrast, the effect of corruption in Western Balkan countries aspiring to join the EU and facing challenges of poor governance and underdeveloped institutions is less pronounced. In that respect, this paper's findings align with the results of studies by Mendez and Sepulveda (2006), Aidt, Dutta & Sena (2008) and Hodge et al. (2011).

The "sanding the wheels" effect of corruption on economic growth in non-EU countries of the Western Balkans necessitates adopting a "zero tolerance" policy toward corruption. Strong institutional performance is the first pillar of an effective anti-corruption policy. This includes establishing rules and legal frameworks that meet high standards and allow for effective enforcement. The second essential component of strong institutions is the presence of regulatory bodies that operate independently, free from political influence while fulfilling their oversight and control responsibilities. At the same time, they must be accountable to national assemblies and the public. Additionally, it is crucial to

9 That non-EU WB countries from our sample generally exhibit lower governance levels than the EU ones can be inferred from the World Bank's World Governance Indicators Database (World Bank, 2024b).

strengthen their capacities to enable them to perform their tasks effectively. This means it is essential to avoid the pitfall of "institutional isomorphism", where institutions in developing countries resemble those in developed countries in terms of structure, organisation and rules, yet achieve very different outcomes due to a lack of capacity and other factors that hinder their operations (Sakib, 2020).

An effective anti-corruption policy requires merit-based recruitment for civil servants in regulatory bodies and measures to reduce nepotism and clientelism. In countries with poorly performing institutions, fostering a culture of ethics and accountability within the public sector is crucial. Civil servants' salaries should be competitive enough to encourage them to remain in public service. Additionally, it is essential to offer public officers various forms of motivation to promote excellence in their work.

Promoting transparency and accountability in public spending, especially in public procurement, is essential for an effective anti-corruption policy. This can be achieved through regular reviews and audits. Additionally, it is important to create models and indicators that assess the impact of anti-corruption measures and policies. This will provide insights into their effectiveness and highlight any significant weaknesses.

Even though it covered a range of model specifications and testing, our research has its limitations. Further research should explore the level of influence of corruption on economic growth transmission channels such are government size, rule of law, free competition and political stability, all to detect channels that are most sensitive to corruption. Moreover, the research sample should be enlarged to include countries with more nuanced differences in governance regimes (and thus include, say, all European countries).

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Conflict of interests

The authors declare there is no conflict of interest.

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ПРОЦЈЕНА УТИЦАЈА ПЕРЦЕПЦИЈЕ КОРУПЦИЈЕ НА ЕКОНОМСКИ РАСТ КОРИШЋЕЊЕМ GLS МОДЕЛА

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САЖЕТАК

Спроведене су бројне студије како би се истражио утицај корупције на економски раст. Рад има за циљ да открије корелацију између корупције и економског раста на узорку од десет европских земаља за период од десет година (2012-2021). Да би се добиле процјене које нису подложне хетероскедастичности и корелацији, коришћен је метод уопштених најмањих квадрата (Generalised Least Squares - GLS). Истраживање је потврдило свеукупни негативан утицај корупције на БДП по глави становника, фаворизујући хипотезу о „посипању точкова пијеском" ("sanding the wheels"). Процјењује се да је ефекат у статичком моделу у распону између -1,5 (у случају модела са радном снагом) и -0,9 процената (када је радна снага искључена) након повећања нивоа корупције за један поен. У динамичким спецификацијама модела, ефекат је процијењен између -0,65 и -1,36 процената у истој години. Анализа је потврдила различите интензитете утицаја корупције на економски раст у оквиру два режима управљања који се разликују по квалитету институција (један се састоји од земаља које су чланице ЕУ, а други од земаља Западног Балкана које треба да испуне услове за приступање ЕУ). Истраживање сугерише да је негативан ефекат корупције интензивнији у земљама са развијеним институцијама (земље ЕУ). Истраживањем је потврђено да се ефекат корупције на економски раст у таквим земљама креће између 1,57 и 1,94 процената пада БДП-а по глави становника након повећања нивоа корупције за једну јединицу. Ове процјене су много веће од оних које су утврђене за земље Западног Балкана, које нису чланице ЕУ, код којих се пад БДП-а по глави становника креће између 0,29 и 0,46 процената.

Кључне ријечи: *корупција, економски раст, бруто домаћи производ, институције, управљање*