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Determinants of corruption: a panel data analysis of Visegrad countries

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Abstract

Research background: Corruption is a phenomenon that has no borders, thus hindering the proper functioning of the social, economic, and legal systems of a given state. As the rankings assessing the level of corruption in various countries show, transition economies are more vulnerable to corruption than countries that have not undergone changes in the political and economic order. The Visegrad group is an example of such countries. Despite their efforts, these countries' governments have yet to match the evaluation of corruption indices for developed European countries.
Purpose of the article: This study analyses the determinants of corruption in Visegrad countries to identify which determinants are the most impactful and thus should be the focus of Visegrad countries' governments when creating anti-corruption policies.
Methods: Data for the period 1996–2019 from the databases of the World Bank, Transparency International, and the European Central Bank were used for panel data analysis. The study uses a comprehensive set of economic, socio-cultural, and political determinants that can influence corruption. The purpose of this large set of variables is to prevent possible distortion owing to omitted variables.
Findings & value added: The results of the analysis of panel data show the main determinants of corruption in Visegrad countries are economic, political, and socio-cultural (phase of economic

development, openness of the economy, size of the public sector, degree of urbanization, and women's share in the labour force). A significant effect was also demonstrated in the case of regulatory quality and public sector wages. The findings can serve as a valuable resource for policymakers to develop government policies in individual countries and to implement effective anti-corruption tools.

Introduction

Today, corruption is one of society's most serious problems, occurring in all countries of the world, regardless of their economic and social maturity. However, some countries find it more challenging to cope with the side effects arising from the long history of corruption (Popova & Post, 2018, pp. 231–244; Meyer-Sahling & Mikkelsen, 2020). The preconditions for the emergence of corruption in individual countries and institutions are associated with economic transformation. Problems can also be seen in the new dimension of economic governance, which is related to the misorientation of resources (Svensson, 2005, pp. 19–42). When corruption began to develop, many countries, including those in Eastern Europe, were ill prepared for those undesirable changes. The Visegrad countries are an example of such countries (Sicakova-Beblava & Beblavy, 2016, pp. 295–313; Meyer, 2019, pp. 220–233; Snegovaya, 2020, pp. 1162–1182). Their economies are embedded in the legacy of communism, which affects corruption as an accompanying phenomenon of transformation processes (Liptakova, 2020, pp. 81–102; Naxera, 2020, pp. 671–673; Pirro & Della Porta, 2021, pp. 433–450). In particular, as a result of privatisation, transforming economies can be described as more vulnerable to corruption. One of the prerequisites for the development of corruption in such countries is government officials who demand bribes and kickbacks from private agents for state-owned businesses (Holmes, 1999).

Some researchers have already applied panel data to assess the determinants of corruption in different countries (Elbahnasawy & Revier, 2012, pp. 311–333; Picón & Boehm, 2019, pp. 88–100, Bitterhout & Simo-Kengne, 2020, pp. 1–23). Based on the literature, several variables appear to affect the corruption environment in a country. Particular attention is paid to solving current issues of corruption in the European Union (EU) countries, Organisation for Economic Cooperation and Development (OECD) nations, developed and developing countries, as well as the unique problems in individual countries. Like the aforementioned studies, this study applies the analysis of panel data to a set of transition economies, specifically the Visegrad countries. These countries share a similar character in terms of economics and the political environment, rely on the same traditions, and

promote cooperation and stability in the wider region of Central Europe. To date, little research emphasising the influence of selected determinants of corruption in the Visegrad countries has been conducted. Thus, this study attempts to fill the gap in this research area. A wide range of variables that were frequently utilised in previous studies (Billger & Goel, 2009, pp. 299–305; Elbahnasawy & Revier, 2012, pp. 311–333; Picón & Boehm, 2019, pp. 88–100; Bitterhout & Simo-Kengne, 2020, pp. 1–23) were selected for the analysis examining the determinants of corruption and verified to determine which of these are decisive factors for corruption in the Visegrad group.

This paper aims to identify the determinants of corruption in the Visegrad group that are most likely to affect corruption and ascertain which determinants the governments should concentrate on in their anti-corruption policies.

To achieve this goal, the following two hypotheses are verified:

H1: *Countries with a higher level of perception of corruption according to the CPI are characterised by lower corruption control*.

H2: *Corruption in the Visegrad countries is influenced by selected economic, political, and socio-cultural determinants.*

The paper is structured into six parts. The introduction specifies the problems associated with the origin and causes of corruption in the Visegrad countries. The following section provides an overview of the literature on this issue. In the methodology, the data and method used are described. The results section evaluates corruption in V4 countries and the influence of selected determinants on the level of corruption in the V4 countries using panel data analysis. The next section compares our results with those of other studies. The conclusion summarises the findings and provides suggestions for further research.

Literature review

There are several perspectives from scholars and institutions concerning corruption that provide a unified definition for the phenomenon. At its core, corruption is an undesirable phenomenon that affects a country's development. It is also an abuse of public power for private gain (Aidt, 2009, pp. 271–291). According to Picón and Boehm (2019, pp. 88–100), corruption can be described as non-compliance with rules and established principles,

where its frequent manifestations are bribes, embezzlement of funds, or manipulation of information. Corrupt behaviour can also be a means of influencing the rules of the game. These perspectives cover political, economic, bureaucratic, legal, social, and even moral dimensions (Tanzi, 1998, pp. 559–594; Treisman, 2000, pp. 399–457; Serra, 2006, pp. 225–256; Kasik, 2013, pp. 287–291; Montes & Paschoal, 2016, pp. 146–150; Popova & Post, 2018, pp. 231–244; Moldogaziev & Liu, 2020, pp. 475–504; Sviderskyi & Lubentsov, 2020, pp. 125–129). According to Ochulor (2011, pp. 223–228), the source and direction in defining corruption are normally anchored to the author or scholar's disciplinary background. There is no universally unique nor accepted definition in the academic discourse or among members of the general public for corruption. Kwong (2015) believes that under different moral values, standards, and economic organisations, the prohibited actions and forms that corruption takes in the social and institutional systems of developed and developing societies differ. In defining corruption, Nye (1967, p. 418) referred to it as *'an attitude that violates rules or deviates from the ethical public duties due to private-regard influence.'*

Elbahnasawy and Revier (2012, pp. 311–333) comprehensively assessed the economic, political, and sociocultural determinants of corruption using panel data analysis. Another study by Picón and Boehm (2019, pp. 88–100) examined whether different determinants of corruption exist in countries with different levels of corruption. Despite many studies on this topic, to date, there has been no clear consensus on the root causes of corruption (Knack & Omar, 2000; Krajewska & Makowski, 2017, pp. 325–339; Liptakova, 2020, pp. 81–102; Laurent, 2021, pp. 65–91). Several economic variables could impact the benefits or costs of paying or accepting bribes. For example, civil servants' wage rate compared to the private sector wage rate was found to influence the level of corruption (Tanzi, 1998, pp. 559–594). Kotlánová and Kotlán (2013, pp. 660–667) examined the institutional environment's effect on the perception of corruption and the influence of selected determinants using a dynamic panel regression model and concluded that the institutional environment has a significant impact on the causes and spread of corruption.

According to the literature, the economic determinants of corruption include gross domestic product (GDP) per capita, openness to foreign trade, and the size of the public sector (Elbahnasawy & Revier, 2012, pp. 311–333). Some (Lederman *et al*., 2005, pp. 1–35; Serra, 2006, pp. 225–256; Mustapha, 2014, pp. 1–5) argue that the level of economic development of a country (according to GDP/capita) affects the level of corruption and that higher education may increase the likelihood of detecting corrupt practices.

Several studies have shown that a high degree of economic development, as indicated by GDP/capita, has a positive effect on corruption (Deyshappriya, 2015, pp. 135–147; Knack & Azfar, 2003, pp. 1–18; Lederman *et al.*, 2005, pp. 1–35; Serra, 2006, pp. 225–256). At the same time, corruption is an influencing variable, i.e. corruption determines the degree of economic development (Bentzen, 2012, pp. 167–184; Feruni *et al*., 2020). The causal relationship can be tested by regression analysis. According to Treisman (2000, pp. 399–457) and Knack and Omar (2000), greater openness to foreign trade is associated with lower levels of corruption. Elbahnasawy and Revier (2012, pp. 311–333) emphasise that the economic determinants of corruption include trade restrictions such as tariffs and quotas and that increasing natural resources is also an important factor. Similarly, Zhan (2017) and Williams and Le Billon (2017) argued that large amounts of natural resources are an important determinant of a country's level of corruption because they create opportunities for rent-seeking. As Fisman and Gatti (2002, pp. 325–345) and Corrado and Rossetti (2018, pp. 1126–1139) demonstrate, the larger the size of the public sector (defined by a government consumption), the greater the number of government contracts for which bribes can be offered. Picón and Boehm (2019, pp. 88–100) argue that a more equal distribution of income in the economy reduces the incidence of corruption.

Another view is offered by studies evaluating the socio-cultural determinants of corruption (e.g. Treisman, 2000, pp. 399–457; Serra, 2006, pp. 225–256; Fisman & Gatti, 2002, pp. 325–345; Elbahnasawy & Revier, 2012, pp. 311–333). Research (Treisman, 2000, pp. 399–457; Fisman & Gatti, 2002, pp. 325–345) has shown that the preconditions in large countries increase the likelihood of civil servant bribes. In addition, Swamy *et al.* (2001, pp. 25–55) have found that the level of corruption is lower in countries where women occupy a larger share of parliamentary seats and a larger share of the labour force. According to Feruni *et al*., 2020, a lower degree of urbanization, i.e. a higher concentration of the rural population, also negatively affects the incidence of corruption in the country. According to Treisman (2000, pp. 399–457), Serra (2006, pp. 225–256), and Elbahnasawy and Revier (2012, pp. 311–333), the country's legal system is a factor influencing the incidence of corruption. The authors emphasise the importance of the existence of a common-law tradition and draw attention to the risk of corruption associated with corrupt government officials. Popova and Post (2018, pp. 231–244), searched for answers to the question of whether Eastern European courts are effectively restricting policies and upholding the rule of law.

Political determinants are analysed in the literature from other variables influencing corruption (e.g. Treisman, 2000, pp. 399–457; Lederman *et al*., 2005, pp. 1–35; Pirvu, 2015, pp. 65–82; Sicakova-Beblava & Beblavy, 2016, pp. 295–313; Snegovaya, 2020, pp. 1162–1182; Laurent, 2021, pp. 65–91). Some of the aggregated global governance indicators (WGI) include the Political Stability and the Voice and Accountability Indices (Kaufmann *et al*., 2006). The importance of political stability in influencing corruption has also been emphasised in other studies (e.g. Lederman *et. al*., 2005, pp. 1–35; Serra, 2006, pp. 225–256) as political instability may make officials more prone to accepting or even demanding bribes.

Some of the extent, literature addresses current issues of corruption in the Visegrad countries (e.g. Kasik, 2013, pp. 287–291; Sicakova-Beblava & Beblava, 2016, pp. 295–313; Merickova *et al*., 2017, pp. 99–120; Meyer, 2019, pp. 220–233; Snegovaya, 2020, pp. 1162–1182; Pirro & Della Porta, 2021, pp. 433–450). Specifically, these studies emphasise the differences in the forms of corruption and its measurement, potential solutions, and anti-corruption measures in connection with their common historical development and reform tendencies, including the modernization of public administration and the public sector. Meyer-Sahling and Mikkelsen (2020) and Meyer (2019, pp. 220–233) assessed the effectiveness of disciplinary and ethical codes in reducing corruption in the civil service and government interventions in the conditions of Poland. Krajewska and Makowski (2017, pp. 325–339) highlight that anti-corruption policy poses a threat to the standards of a democratic state. Pirro and Della Porta (2021, pp. 433–450) and Snegovaya (2020, pp. 1162–1182) address the effects of corruption in Hungary and reveal its political context. Lendvorský *et al*. (2021, pp. 1–15) examine the enforceability of legal responsibility for corrupt acts against public officials in Slovakia for the period 1994–2020. Their results point to low levels of accountability, especially under left-wing governments. Němec *et. al*. (2021, pp. 1–16) assess the economic impacts of corruption on the size of the shadow economy, sources of economic growth, and the tax burden in the Czech Republic and generalise the effects of corruption and its consequences for other post-communist EU member states.

In connection with approaches analysing the consequences of corruption, several studies should be mentioned (e.g. Billger & Goel, 2009, pp. 299–305; Picón & Boehm, 2019, pp. 88–100; Bitterhout & Simo-Kengne, 2020, pp. 1–23). Picón and Boehm (2019, pp. 88–100) examine whether the determinants of corruption in highly corrupt countries differ from those that can be found in less corrupt nations. They conclude that some variables may have different effects on countries with different levels of corruption. Conversely, other determinants may have the same impact on countries

with different levels of corruption. Picón and Boehm (2019, pp. 88–100) argue that variables such as the size of the government and the proportion of the Protestant population are good predictors of the level of corruption, but only for the most and least corrupt countries and not those with medium levels of corruption. However, other variables, such as the degree of democracy, economic freedom, and income levels, remain critical determinants for all levels of corruption. This suggests that if there are differences according to the level of corruption, the policies adopted to control this phenomenon should likewise be distinguished.

According to several studies, a more comprehensive and interdisciplinary approach to understanding the full picture of corruption is essential (Park, 2003, pp. 28–49; Elbahnasawy & Revier, 2012, pp. 311–333; Picón & Boehm, 2019, pp. 88–100). According to Bitterhout and Simo-Kengne (2020, pp. 1–23), using different indices of corruption perception may be useful to provide an accurate view of corruption. A distinction must always be made between the tool used to measure the perceptions of corruption perception and how its results differ from the actual experience with corruption. These facts allow for the correct conclusions to be drawn in individual research.

Corruption is difficult to quantify as a statistical variable. The main reason is that most of the data about corruption are not available in the form of 'hard' data. Comparable objective data in this regard are practically nonexistent; thus, most surveys and measurements are based on the subjective evaluation of respondents (Kauffman *et al*., 2006; Olken, 2009, pp. 950–966; Bitterhout & Simo-Kengne, 2020, pp. 1–23). Corruption level indicators are, therefore, based on so-called 'soft' data, which show considerable variability depending on the situation and time they are obtained. On the other hand, if there is an interest in fighting corruption, it is necessary to quantify this phenomenon and determine its extent in individual countries. Existing indicators of the level of corruption are, therefore, widely used, despite their shortcomings. Such indicators include the currently best-known corruption indicator, the Corruption Perceptions Index (CPI), which is published annually by Transparency International (Transparency International, 2019, 2020). The CPI belongs to the category of composite indices, which are compiled by a combination of several indicators of corruption, thus including more information and eliminating possible one-sided deviations of the obtained results. Another group of indices consists of the so-called 'expert evaluations', most notably the Control of Corruption (CC) Index. The CC indicator belongs to a wide group of worldwide governance indicators compiled by the World Bank (Linhartová & Volejníková, 2015, pp. 25–39).

Research method

In line with the goal of this paper, two hypotheses are verified:

H1: *Countries with a higher level of perception of corruption according to the CPI are characterised by lower corruption control.*

H2: *Corruption in the V4 countries is influenced by selected economic, political, and socio-cultural determinants*.

Data

This study uses the indicators from Transparency International, the World Bank database, and the European Central Bank. The dependent variables are the Corruption Perception Index (CPI) and the Control of Corruption Index (CC). The Corruption Perception Index (CPI) ranks countries based on how corrupt a country's public sector is perceived to be, with a score of 0 representing a very high level of corruption and a score of 100 representing a very low level (Transparency International, 2019). The Control of Corruption (CC) Index captures **'***perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as* "*capture*" *of the state by elites and private interests*' (Kauffmann *et al*., 2010, p. 4). The index ranges from -2.5 or 0 (a completely corrupted government) to 2.5 or 100 (no corruption).

Indicators for assessing the impact of corruption are chosen to reflect the widest possible range of current variables that may affect corruption (economic, political, and socio-cultural). Based on the literature research (Park, 2003, pp. 29–48; Kaufman *et al*., 2006, 2010; Elbahnasawy & Revier, 2012, pp. 311–333; Ghaniy & Hastiadi, 2016, pp. 1–10; Picón & Boehm, 2019, pp. 88–100; Bitterhout & Simo-Kengne, 2020, pp. 1–23) the most frequently mentioned determinants of corruption were selected as the independent influencing variables. Independent indicators used in our analysis are from the World Bank's world development indicators (worldwide governance indicators) and focus on a specific area of governance quality (Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, and Rule of Law). These indicators range from -2.5 to 2.5, where the highest possible value of the indicator is desirable (Kaufmann *et al*., 2010, pp.1–29). '*Voice and Accountability (VA) captures perceptions of the extent to which a country's citizens can participate in selecting their government. Political Stability (PS) captures perceptions of the likelihood that the government will be destabilized or overthrown. Gov-*

*ernment Effectiveness (GE) captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures. Rule of Law (RL) captures perceptions of the extent to which agents have confidence in and abide by the rules of society. Regulatory Quality (RQ) captures perceptions of the ability of the government to formulate and implement policies and regulations"(*Kaufmann *et al*., 2010, p. 4). All indicators range from -2.5 or 0 to 2.5 or 100.

Other independent variables in the analysis were taken from World Bank database (indicators 1-9) and European Central Bank (indicator 10). Those indicators are as follows: 1) Gross Domestic Product (PPP GDP/capita), where the purchase price is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products, 2) Openness to Trade represents the external balance on goods and services, which is calculated by the total number of exports of goods and services minus the total number of imports of goods and services (previously non-factor services), and 3) Natural Source Endowment (% of merchandise exports), which is defined by ores and metals exports (% of merchandise exports), 4) Government consumption (% of GDP), which is defined by the general government final consumption expenditure (% of GDP), 5) Country Population, 6) Rural Population, 7) Percentage of Females in the Labour Force, and 8) Percentage of Seats Held by Women in National Parliaments (%), which is defined by the proportion of seats held by women in national parliaments (%), 9) the Gini index, which measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution (World Bank, 2022), and 10) Public Sector Wage, which is expressed by the unit labour costs in the public sector (an index) (European Central Bank, 2022).

The sample of countries consists of Visegrad group countries (Czechia, Slovakia, Hungary, and Poland), which are analysed for the period 1996–2019. This time series is sufficient to demonstrate the possible influence of independent variables on the level of corruption. Table 1 provides an overview of the basic statistics of the data used. The correlation matrix of the dataset is presented in Figure 1.

Methods

The most commonly used method for estimating the effect of several independent variables on one dependent variable is multiple regression analysis. The simplest multidimensional regression model contains two explanatory variables. Multiple regression analysis is suitable for time se-

ries analysis but not for panel data analysis (Wooldridge, 2010). Panel data have several advantages over cross-sectional or time series data (see Hsiao, 2007) and are receiving increasing attention in econometric analyses. Panel data include a time series of observations of a number of individuals. The observations contain two dimensions of data: the cross-sectional dimension, indicated by subscript *i,* and the time series dimension, indicated by subscript *t*. (Davies & Lahiri, 1995, pp. 205–227; Hsiao, 2007).

The panel analysis was performed on independent variables representing possible determinants of corruption and two dependent variables. The CPI and the CC Indices were selected as independent variables. Due to the fixed number of monitored units (countries) over time, the resulting panel data set is balanced and classical tools for estimating panel data models can be used (Baltagi, 2005). Greene (2003) presents a basic regression model of panel data:

$$y_{it} = \beta_1 x_{it1} + \beta_2 x_{it2} + \ldots + \beta_k x_{itk} + \alpha_1 z_{i1} + \alpha_2 z_{i2}\, \alpha_3 + \ldots + \alpha_q z_{iq} + u_{it} \quad (1)$$

where:

the index i	the cross-sectional dimension $i = 1,\ldots, n$;
the index t	the time dimension $t = 1,\ldots, t$;
x_1 to x_k	explanatory variables not including the vector of units;
z_1 to z_q	individual effects where the possible vector includes units.

Individual effects do not change over time. There are three methods of panel regression: Pooled OLS Regression, the Fixed Effect Model (FEM), and the Random Effects Model (REM) (Baltagi, 2005; Wooldridge, 2010; Hsiao, 2014).

Formal recommendations on the suitability of individual panel models are given by panel diagnostics tests (see, for example, Baltagi, 2005; Jaba *et al*., 2017; Awan *et al*., 2018,). The output of the tests is a comprehensive report that provides recommendations on the suitability of individual panel models. One of the panel diagnostic tests is the F-test, which is done to determine whether the Pooled OLS model or FEM should be used. In the case that the p-value > 0.05, the Pooled OLS model is deemed valid. Another frequently used panel diagnostic test is the Hausman test, which is employed as the basis for deciding whether FEM or REM is more appropriate. If the p-value > 0.05, REM is considered valid (Jaba *et al*., 2017).

The aforementioned panel diagnostic tests identified that FEM should be used to perform the analysis. If the individual effects z_1 to z_q are unobservable, but correlated with explanatory variables, the solution is to include all effects in the predictable conditional average using the relation

$\alpha i = \alpha_1 z_{i1} + \alpha_2 z_{i2} \alpha_3 + \ldots + \alpha_q z_{iq}$ and the FEM equation is as follows (Baltagi, 2005):

$$y_{it} = \alpha_i + \beta_1 x_{it1} + \beta_2 x_{it2} + \ldots + \beta_k x_{itk} + u_{it} \quad (2)$$

where:

y_{it}	dependent variable observed for individual *I* at time x_{it1};
β	the *k x 1* matrix of parameters;
α_i	a specific constant for each cross-sectional unit;
u_{it}	the error term.

FEM has several advantages, such as the possible correlation of individual and time-specific effects with explanatory variables. This model does not even require that investigators model their correlation patterns. However, FEM also has several disadvantages; for example, the number of unknown parameters increases with the number of sample observations and the estimator does not estimate time-invariant coefficients (Hsiao, 2014, p. 11).

Results

This section evaluates the Visegrad countries in terms of perceptions of corruption and corruption control, and the impact of selected determinants on the level of corruption in the Visegrad countries using panel data analysis.

Evaluation of corruption in V4 countries

As shown in Figure 2, the Visegrad countries trail far behind the Western European member states and the EU average, as shown in the average CPI scores from 1996 to 2019. The dashed line indicates the EU average.

In assessing corruption, conflicts of interest for public officials and in the field of public procurement are a common feature of individual V4 countries (Transparency International, 2020). In 2019, Hungary had the worst CPI score. The paradox is that for several years (1998–2006) it was ranked 1st in the V4 group. The reason stems from several changes, new laws, and poor negotiations, all of which significantly worsened Hungary's situation. According to Transparency International, Hungary has *'taken steps to undermine judicial independence, which weakens their ability to prosecute cases of high-level corruption'* (2022b, p. 22). On the contrary,

the country receiving the best rating in 2019 was Poland, which has consistently ranked 1st for several years. Nevertheless, the current situation in Poland is not ideal. Due to drastic steps, the government is gradually taking control of state institutions and the country's situation is deteriorating. The Czech Republic has been ranked 2nd in the V4 since 2015. Its current woes centre on the privatisation of public interests and the lack of independent media, as journalists often face strong pressure from public officials. The scandals concerning the Czech Prime Minister's efforts to obtain public money through EU subsidies for his private company point to a severe lack of political integrity (Transparency International, 2022b, p. 22). In 2019, Slovakia ranked 3rd. In recent years, there have been cases of conflicts of interest in Slovakia. However, a big problem that occurred in 2018 was the murder of an investigative journalist, which brought to light Slovakia's weakness in fighting corruption (Transparency International, 2020).

The methods of tackling corruption affect all EU countries to varying degrees, particularly at the financial and social levels. At the European and international levels, there are more tools to fight corruption, but the degree of their implementation varies from country to country. Hypothesis 1, 'Countries with a higher level of perception of corruption according to the CPI are characterised by lower corruption control' is verified. We assume (with reference to, e.g., Zafarullah & Siddiquee, 2001, pp. 465–486; Kaufman *et al*., 2010; pp. 465–486; Moene & Søreide, 2016, pp. 147–163) that countries with a high level of corruption can be expected to have less perfect control systems and, therefore, a less sophisticated system of corruption control and fewer anti-corruption measures implemented. The evaluation of the levels of corruption and corruption control in the V4 countries in the years 2000, 2010, and 2019 show that all countries have higher levels of corruption, as measured by the CPI, and are characterised by a lower level of corruption control, as measured by the CC Index (see Table 2). Slovakia had the highest level of corruption in the V4 countries in 2000 and 2010, which also reflects the results of low corruption control. In 2019, Hungary had the highest level of corruption and the lowest control over corruption. On the contrary, in the same year, Poland had the lowest level of corruption and the highest level of corruption control.

Compared to other European countries, according to selected models of public administration traditions, the V4 countries are characterised by a high level of perception of corruption and a poorly developed system of corruption control, including the implementation of anti-corruption measures. As Table 2 shows, except for Italy and Greece, which are representatives of the Mediterranean/South European model, the Visegrad group countries have some of the worst ratings concerning the people's percep-

tion of corruption. In the overall assessment of corruption, the V4 countries have long been below the average level of corruption for European countries. Of the European countries, the Balkan model countries (e.g. Bulgaria, Romania) have a worse assessment of corruption than the V4 countries.

The influence of selected determinants on the level of corruption in the V4 countries using panel data analysis

Prior to conducting the panel data analysis, the variables were tested for multicollinearity using the Pearson correlation coefficient. According to Senavirtna and Cooray (2019, pp. 1–9), *'if the correlation coefficient between two variables is greater than 0.8 or 0.9, multicollinearity is a serious problem'*. As can be seen from the correlation matrix (Figure 1), none of the independent variables are correlated at such a high level; thus, the problem of multicollinearity cannot be assumed between the variables.

Using the F-test, FEM was found to be more suitable than the Pooled OLS model. The low p-value (0.0108251 for CPI and 0.000738987 for the CC Index) accounted for the null hypothesis that the Pooled OLS model is adequate, in favour of an alternative with fixed effects. Hausman's test showed that FEM is more suitable than REM. Specifically, the low p-value (0.0256922 for CPI and 0.0089649 for the CC Index) rejected the null hypothesis that REM is adequate, in favour of an alternative with fixed effects.

Table 3 shows the results of FEM for the CPI and the CC Indices as variables that express the level of corruption in the country. The coefficient of determination was 0.94 for the CPI variable and 0.95 for the CC variable model. Thus, the first model explains 94% of the variability and the second explains 95% of the variability of the explained variable. Probability (F-statistics) indicates the overall significance of the regression model. A low value of F-statistics implies that overall, the regression is meaningful.

Hypothesis 2, that corruption in the Visegrad countries is influenced by specific economic, political, and socio-cultural determinants, was verified. The regression model was tested for endogeneity to verify that the explanatory variables did not correlate with the error term. Hausman's test was used for this purpose (Jaba *et al*., 2017). Hausman's test was performed for several variables. However, the variables suspected of possible endogeneity due to the higher correlation coefficient (see Figure 1) were GDP/capita, Openness to Trade and Public Sector Wage for a model with CPI. In that case, a significant p-value of 0.239318 is higher than 0.05 and the null hypothesis concerning the exogeneity of independent variables was not rejected.

Based on literature research (e.g., Treisman, 2000, pp. 399–457; Lederman *et al*., 2005, pp. 1–35; Serra, 2006, pp. 225–256; Elbahnasawy & Revier, 2012, pp. 311–333; Deyshappriya, 2015, pp. 135–147; Pirvu, 2015, pp. 65–82; Sicakova-Beblava & Beblavy, 2016; Picón & Boehm, 2019, pp. 88–100; pp. 295–313; Snegovaya, 2020, pp. 1162–1182; Laurent, 2021, pp. 65–91), a positive value of the regression coefficient can be expected for most of the monitored influencing variables (a higher value of the explanatory variable causes a higher value of the explanatory variable). A negative regression coefficient can be expected in the case of Rural population and GINI coefficient. Previous studies have shown that a higher degree of urbanization, therefore a lower volume of Rural population, causes a better assessment of corruption (Elbahnasawy & Revier, 2012, pp. 311–333; Feruni *et al*., 2020). Similarly, the lower the value of the GINI coefficient (i.e. more equal income redistribution), the better the corruption rating (Picón & Boehm, 2019, pp. 88–100).

1) From the achieved results of Economic determinants, we can state that GDP/capita is statistically significant at the 1% level in the case of CPI. This means that corruption is perceived less in richer countries than in poorer countries. With all other variables constant, a 1% increase in real GDP/capita increases the CPI by 0.4. However, this impact was not statistically demonstrated for the variable CC. Openness of Trade affects corruption in both models and is significant at the 1% level. At the constants of other variables, a 1% increase in the ratio of the sum of exports and imports to GDP reduces the CPI and the CC by 0.049 and 0.025, respectively. Public Sector Wage is statistically significant at the 1% level in the case of CPI regression. A one- standard deviation increase in public sector salaries increases the perceived corruption by 0.005. Similarly, the GINI coefficient is statistically significant at the 1% level in the CC regression. Thus, in the case of the Visegrad countries, more equal income redistribution can be related to a lower level of perceived corruption. A one-standard deviation increase of the GINI coefficient increases the corruption level by 0.028 in the CC regression model. The panel data analysis also shows an inverse relationship between the Size of the Public Sector (expressed by Government Consumption) at the 5% level of significance. A larger public sector can provide more room for rent-seeking activities and corruption practices. A one-standard deviation increase of Government Consumption decreases the CPI and CC by 0.010 and 0.037, respectively.

2) In terms of Socio-cultural determinants, the results of the analysis of panel data show that the number of rural inhabitants affects the perceived corruption/corruption at the 1% level in the case of CPI regression and 5% at the level of CC regression. An increase in the rural population by one

standard deviation reduces CPI and CC by 0.06 and 0.08, respectively. A higher number of women in the workforce reduces the level of corruption in both regressions with statistically significant coefficients at the 1% level. Increasing the share of women in the labour force by one standard deviation reduces CPI and CC by 0.03 and 0.05, respectively.

3) If we focus on Political determinants, a more robust perception of Regulatory Quality appears to go hand in hand with a lower level of corruption. The analysis showed that a better evaluation of the quality of regulation using one standard deviation is accompanied by a better evaluation of the level of corruption by 0.033 in CC regression, with statistical significance at the 1% level.

As follows from previous studies e.g. Picón and Boehm (2019, pp. 88–100) political and economic determinants explaining corruption contain variables such as the type of political regime, the effectiveness of the justice system, and the level of economic freedom. Corruption levels might be caused by weaknesses in these areas. In our research, we assume the influence of political determinants (Political Stability, Rule of Law, and Regulatory Quality) and economic determinants (GDP/per capita, Openness to Trade or % of Females in the Labour Force). The indicators % of women in labour force or % of women in national parliaments was also evaluated in previous studies, e.g. Swamy *et al*. (2001, pp. 25–55); Elbahnasawy and Revier (2012, pp. 311–333). Swamy *et al.* (2001, pp. 25–55) also showed that corruption is less severe in countries where women hold a large share of parliamentary seats and occupy a large share of the labour force. The empirical evidence of economic variables suggests that 1) the lower the income per capita, the lower the integration of the country into the world economy and 2) the bigger the size of its government, the higher the level of corruption (Serra, 2006, pp. 225–256; Picón & Boehm, 2019, pp. 88–100).

Discussion

As previously mentioned, it is necessary to take a more comprehensive and interdisciplinary approach to understanding the full picture of corruption regarding the influence of several determinants (Park, 2003; pp. 28–49; Elbahnasawy & Revier, 2012, pp. 311–333; Picón & Boehm, 2019, pp. 88–100; Bitterhout & Simo-Kengne, 2020, pp. 1–23). There are many causes of corruption and its spread. In some countries, political change has weakened social, political, and legal institutions and opened the doors to new opportunities, including corrupt ones (Lederman *et al*., 2005, pp. 1–35;

Svensson, 2005, pp. 19–42; Matei & Matei, 2009, pp. 145–171; Ochulor, 2011, pp. 223–228; Sviderskyi & Lubentsov, 2020, pp. 125–129). Elsewhere, political and economic liberalisation has simply exposed corrupt practices that were previously hidden. According to Blagojević and Damijan (2013, pp. 133–158), the period of transformation is mainly caused by the spillover of corrupt practices in trade and services and public administration. For these reasons, corruption is perceived as a serious problem, particularly by post-communist transforming economies, including the analysed Visegrad countries.

Although several economists have already addressed the determinants of corruption, scholars have yet to reach a consensus on the causes of corruption (Tanzi 1998, pp. 559–594; Lederman *et al.*, 2005, pp. 1–35; Serra, 2006, pp. 225–256; Elbahnasawy & Revier, 2012, pp. 311–333; Kasik, 2013, pp. 287–291; Pirvu, 2015, pp. 65–82; Montes & Paschoal, 2016, pp. 146–150; Popova & Post, 2018, pp. 231–244; Snegovaya, 2020, pp. 1162–1182; Laurent, 2021, pp. 65–91). In connection with the aim of this paper, Hypothesis 1 was verified: *Countries with a higher level of perception of corruption according to the CPI are characterised by lower corruption control.* For the V4 countries in 2000, 2010, and 2019, it can therefore be confirmed that a higher level of corruption in most countries for the period under review is accompanied by a lower level of corruption control and vice versa (see Table 2). If we evaluate the level of corruption and its relationship with corruption control in the same years for other groups of European countries with traditional public administrations (i.e. within the continental model of public administration, the Scandinavian model, and the southern European model), we find similar results to the Visegrad group. Moreover, in the continental traditional model countries or the Mediterranean/Southern European countries employing the public administration model, a higher level of perception of corruption is accompanied by a lower level of corruption control and vice versa. Although each group of countries is characterised by a similar tradition of public administration and human resources management system, we also find differences between countries in one group. The Scandinavian countries have long had the lowest level of corruption in Europe, which is due to their sophisticated government control and legislative system, and this fact also reflects the results of corruption control. The only exception is Estonia, which has a higher level of perception of corruption and a lower level of corruption control. However, Estonia has long followed the Finnish system, which is also reflected in the improving results of the corruption assessment in 2019 (a reduction of the corruption rate and an increase in the control of corruption). Based on the results of the CPI and CC Indices in other European

countries (see Table 2), we can state that countries with higher levels of corruption have less sophisticated systems of corruption control and vice versa. According to Billger and Goel (2009, pp. 299–305), the existing level of corruption depends on the capacity to control it. Previous studies have found that the causes of corruption are different in highly corrupt countries compared to the least corrupt countries. They also found that some principles of corruption control could be reconsidered, especially among the most and least corrupt nations.

Hypothesis 2 was also verified in this study: *Corruption in the V4 countries is influenced by selected economic, political, and sociocultural determinants.* Results with the use of panel data analysis show that corruption in countries with lower *GDP per capita* is larger in scale than in richer countries (see Table 3). This supports the findings of several studies (e.g., Knack & Omar, 2000; Elbahnasawy & Revier, 2012, pp. 311–333) and confirms the same technique can be applied to evaluate the Visegrad countries. Many studies (e.g. Knack & Omar, 2000) consider a level of economic openness to be closely linked to lower levels of corruption. These conclusions were also confirmed for the selected transition economies. The size of the public sector measured by *Government Consumption* negatively affects corruption in the Visegrad countries. *The public sector scale* and the associated rent-seeking activities generate opportunities for corruption in a selected set of countries. This confirmed the conclusion of Fisman and Gatti (2002, pp. 325–345). The extent of *urbanization and the size of the urban population* also positively affect the level of corruption. Some studies (e.g. Swamy *et al*., 2001, pp. 25–55) consider women to be less prone to corrupt practices. This conclusion was also confirmed for the selected transition economies. Finally, public sector wages also affect the level of corruption. Countries with higher salaries in *the public sector perform* better in corruption indices. Such a conclusion confirms Tanzi's (1998, pp. 559–594) conclusions for the Visegrad states. Of the political determinants, only the influence of *Regulatory Quality* was confirmed for the Visegrad states. Other determinants of corruption listed in the literature search section have not been proven for this group. It is essential to mention that the analysis results cannot be generalised, and apply only to the selected set of countries and the particular time period. The results of our research have showed that for the period 1996–2019 in the V4 countries, economic and socio-cultural determinants were the predominant influence on corruption. However, the impact of political determinants in our case of regulatory quality concerning corruption control was also confirmed. Similar to our research, other studies confirm the influence of several determinants (economic, political, social, or historical) on corruption (e.g. Nowak, 2001; Lederman *et al*.,

2005, pp. 1–35; Ochulor, 2011, pp. 223–228; Montes & Paschoal, 2016, pp. 146–150; Merickova *et al*., 2017, pp. 99–120; Liptakova, 2020, pp. 81–102; Meyer-Sahling & Mikkelsen, 2020; Laurent, 2021, pp. 65–91).

The impact of indicators on corruption perceptions and control varies from country to country due to different approaches to tackling corruption, the degree of corruption (Billger & Goel, 2009, pp. 299–305; Bitterhout & Simo-Kengne, 2020, pp. 1–23), and the type and form of corruption (Olken, 2009, pp. 950–964; Mustapha, 2014, pp. 1–5; Picón & Boehm, 2019, pp. 88–100). Based on the literature on corruption determinants, a trend of the influence of economic, political and socio-cultural indicators at the level of perception of corruption and corruption control can be assumed (Elbahnasawy & Revier, 2012, pp. 311–333; Picón & Boehm, 2019, pp. 88–100) Compared to our study, Park (2003, pp. 29–48) provides incremental information on the determinants of corruption, showing that the main variables that determine the level of corruption include economic freedom, socio-political stability, the rule of law, and national culture. Ghaniy and Hastiadi (2016, pp. 1–10) add that there are differences in the determinants of corruption between the groups of developing and developed countries, measured by development indicators, the CPI, and other indices. The significant impact on the perceived level of corruption in these countries is confirmed by the level of development, democracy, economic freedom, education, political stability or religion.

Conclusions

This study examined the determinants of corruption by analysing panel data using a large data set for the Visegrad countries and an extensive time series. Although there are many studies examining the root causes of corruption, this is still a relatively unexplored area and no real consensus on the basic determinants of corruption has been reached.

Hypothesis 1, which states that the level of perception of corruption is influenced by the level of control of corruption, was verified. The results show that countries with a higher level of perception of corruption are characterised by lower corruption control. The evaluation of the level of perceived corruption and corruption control in the Visegrad countries in the years 2000, 2010, and 2019 has showed that all countries with a higher level of perceived corruption (measured by CPI) are characterised by a lower level of corruption control (measured by CC) compared to other European countries. A panel analysis of data from the Visegrad countries for the period 1996–2019 was performed to verify Hypothesis 2, which

concerns corruption's main determinants. As a result, Hypothesis 2 was verified. The results of the analysis showed that the main determinants of corruption in the Visegrad countries were economic and political (the phase of economic development, openness of the economy, the size of the public sector, the degree of urbanization, and the share of women in the labour force). These indicators were significant in both models: the index of perceived corruption and in the control of corruption. Significance was also demonstrated in the case of the Regulatory Quality and Public Sector Wage. All variables are statistically significant with the country's level of corruption and the Visegrad countries should pay due attention to them in their anti-corruption policies.

The conclusions on the determinants of corruption open a new space for further analysis of the specific causes of corrupt practices in other European countries. Across Europe, the results of corruption indices greatly differ. Therefore, the analysis of the specific causes of these different results is entirely appropriate and deserves more space. However, for anti-corruption measures to be as effective as possible, it is necessary to focus on the most problematic areas. Several surveys in the V4 countries show that there are no specific indicators for measuring and evaluating corruption in the public sector. If an agreement is reached on the specific causes of corruption and appropriate indicators are set for measuring corruption, it will also be possible to focus on effective anti-corruption measures in these countries.

The limitation of the results of the analysis of the determinants of corruption can be seen in the fundamental problem of quantifying corruption; corruption is difficult to identify and quantify. Most of the currently existing indicators are based on soft data. On the other hand, the corruption indicators compiled by the World Bank and Transparency International which were used in this study are the most reliable ones available at this time for economic analyses.

The authors of this article see as a topic for further research not only the solution of the aforementioned issues of corruption in the Visegrad countries, but also their broader context within the European and international contexts. We also see the evaluation of corruption and the influence of legislative determinants, institutional quality or indicators of political accountability using certain international indices (e.g. rule of law, freedom of the press or global competitiveness) as topics for future research. This area has not yet been explored in-depth from an empirical research point of view and thus offers opportunities for further scientific research.

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Annex

Table 1. Descriptive statistics of used variables

Variable	Mean	Median	Std. Dev.	Min	Max
CPI	19.80	5.00	23.00	3.40	63.00
CC	0.41	0.39	0.20	-0.01	0.82
Voice and Accountability	0.93	0.97	0.17	0.32	1.18
Political Stability	0.86	0.91	0.23	0.15	1.26
Government Effectiveness	0.75	0.75	0.18	0.37	1.10
Regulatory Quality	0.97	1.00	0.19	0.51	1.31
Rule of Law	0.71	0.71	0.23	0.16	1.15
GDP/capita (PPP)	$2.24e^{+004}$	$2.28e^{+004}$	$5.22e^{+003}$	$1.20e^{+004}$	$3.34e^{+004}$
Openness to trade	0.25	-0.29	4.47	-13.20	8.75
Natural resources endowment	2.76	2.29	1.19	1.17	5.86
Government consumption	19.80	19.70	1.55	17.10	25.30
Country population	$1.60e^{+007}$	$1.02e^{+007}$	$1.30e^{+007}$	$5.37e^{+006}$	$3.87e^{+007}$
Rural population	35.60	36.80	7.10	25.50	46.30
% of females in labor force	60.30	61.40	4.22	48.60	69.30
% of seats held by women	16.70	17.00	5.23	8.30	29.10
GINI	29.00	27.70	3.24	24.70	38.00
Public sector wage	76.30	81.20	23.40	26.80	124.00

Source: own calculations based on Transparency International (2022a), World Bank (2021,2022) and European Central Bank (2022).

Table 2. CPI and CC in selected European countries

Selected countries - tradition	2000		2010		2019	
Visegrad group	**CPI**	**CC**	**CPI**	**CC**	**CPI**	**CC**
Czechia	4.3	62.4	4.6	66.6	56	68.5
Slovakia	3.5	64.9	4.3	64.7	50	64.4
Hungary	5.2	77.6	4.7	68.5	44	57.7
Poland	4.1	76.1	5.3	71.9	58	71.1
Continental model						
Belgium	6.1	90.9	7.1	91	75	91.3
Germany	7.6	93.4	7.9	93.3	80	95.5
Austria	7.7	92.9	7.9	91.9	77	90.9
France	6.7	89.3	6.8	89.5	69	88.9
Luxembourg	8.6	94.4	8.5	95.7	80	98.1
Netherlands	8.9	97	8.8	97.6	82	96.6
Slovenia	5.5	80.2	6.4	79.5	60	80.3
Scandinavian model						
Denmark	9.8	99.5	9.3	100	87	97.6
Finland	10	100	9.2	98.1	86	99
Sweden	9.4	99	9.2	99	85	98.6
Estonia	5.7	79.2	6.5	80.5	74	90.4
Mediterranean/South European model						
Portugal	6.7	85.3	6	82.9	62	77.4
Italy	4.6	72.2	3.9	61.9	53	62
Spain	7	89.8	6.1	82.4	62	73.6
Greece	4.9	75.1	3.5	56.7	48	56.3

Note: CPI was range on the scale (0-10) till 2011, from 2012 on the scale (0-100), CC is on the scale (0-100).

Source: own calculations based on Transparency International (2022a) and World Bank (2021).

Table 3. Results of the panel data analyses

Variable	CPI					CC				
	Coeff.	*Std. Error*	*t-ratio*	*p-value*		*Coeff.*	*Std. Error*	*t-ratio*	*p-value*	
Voice and Accountability	-2.838	38.524	-0.074	0.9086		-0.672	2.859	-0.235	0.2986	
Political Stability	11.386	12.398	0.918	0.1933		0.193	0.269	0.716	0.3225	
Government Effectiveness	1.712	31.559	0.054	0.6537		-0.003	0.088	-0.033	0.2316	
Regulatory Quality	0.0520	29.041	0.795	0.7062		0.033	0.225	0.148	0.0013	***
Rule of Law	13.338	35.826	0.372	0.1232		0.660	0.208	3.179	0.7910	
GDP/capita (PPP)	0.424	0.953	4.453	0.0085	***	0.100	0.000	0.545	0.05751	
Openness to trade	0.0485	4.791	0.101	0.0007	***	0.025	0.007	3.649	0.0037	***
Natural resources endowment	-8.495	3.282	-2.589	0.3400		0.015	0.031	0.491	0.7094	
Government consumption	-0.010	0.000	-0.673	0.0130	**	-0.037	0.016	-2.330	0.0416	**
Country population	14.686	4.735	3.101	0.3851		0.000	0.000	-1.487	0.6442	
Rural population	-0.05992	1.700	-3.525	0.0013	***	-0.084	0.033	-2.524	0.0204	**
% of females in labor force	0.00312	1.315	0.237	0.0016	***	0.0053	0.012	4.575	0.0015	***
% of seats held by women	0.424	1.518	0.280	0.2024		-0.008	0.009	-0.809	0.5068	
GINI	-0.3035	429.519	-0.864	0.6220		-0.028	0.010	-2.828	0.0019	***
Public sector wage	0.00541	0.705	0.767	0.0022	***	0.004	0.003	1.156	0.8224	
R^2			0,939518					0,953218		
Adjusted R^2			0,930993					0,943130		
Prob (F-statistic)			$1{,}00^{e-10}$					$7{,}60^{e-10}$		

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

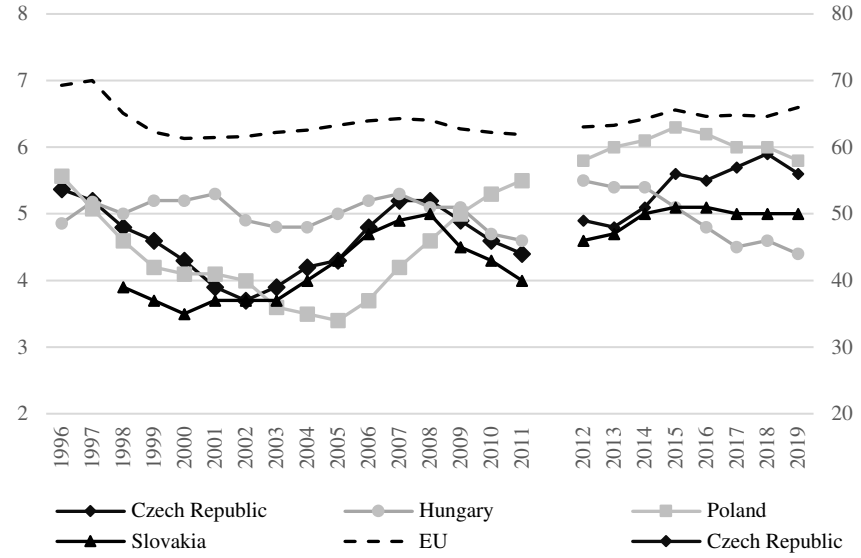
Source: own calculations based on Transparency International (2022a), World Bank (2021,2022) and European Central Bank (2022).

Figure 1. Correlation matrix

Variable																		
CPI	1,000																	
CC	0,087	1,000																
Voice and Accountability	-0,373	-0,558	1,000															
Political Stability	0,033	0,084	0,337	1,000														
Government Effectiveness	0,041	0,263	0,478	0,569	1,000													
Regulatory Quality	0,142	0,405	0,575	0,415	0,710	1,000												
Rule of Law	0,019	0,531	0,533	0,388	0,654	0,661	1,000											
GDP/capita (PPP)	0,659	0,141	0,222	0,186	0,408	0,331	0,277	1,000										
Openess to trade	0,709	0,170	-0,299	-0,010	0,244	0,174	0,264	0,759	1,000									
Natural resources endowment	-0,215	0,183	0,194	-0,200	-0,487	-0,397	-0,357	-0,601	-0,580	1,000								
Government consumption	-0,348	-0,027	-0,031	0,223	0,147	0,158	0,174	-0,200	-0,266	-0,347	1,000							
Country population	0,053	0,402	0,145	-0,406	-0,467	-0,254	-0,062	-0,257	-0,153	0,692	-0,540	1,000						
Rural population	-0,029	-0,107	0,093	-0,071	-0,227	-0,299	-0,642	-0,311	-0,393	0,530	-0,303	0,146	1,000					
% of females in labor force	0,054	0,138	0,289	0,433	-0,557	-0,465	-0,470	-0,322	-0,143	0,182	-0,006	0,154	0,352	1,000				
% of seats held by women	0,399	0,120	0,156	-0,113	0,000	0,087	-0,052	0,380	0,136	0,313	-0,610	0,481	0,236	-0,258	1,000			
GINI	-0,035	-0,169	-0,086	-0,498	-0,675	-0,393	-0,327	-0,558	-0,243	0,555	-0,211	0,792	0,125	0,401	0,110	1,000		
Public sector wage	0,726	0,135	0,401	-0,056	0,002	0,058	0,057	0,798	0,633	-0,312	-0,176	0,065	-0,157	0,064	0,375	-0,032	1,000	

Source: own calculations based on Transparency International (2022a), World Bank (2021,2022) and European Central Bank (2022).

Figure 2. Evaluation of Corruption Perception Index in Visegrad countries



Note: CPI was range on the scale (0-10) till 2011, from 2012 on the scale (0-100)

Source: own calculations based on Transparency International (2022a).