

# Impact of Corruption on V4 Countries Economic Growth

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## **Abstract**

*Corruption is a serious problem the society faces since time immemorial. It is a problem that is persistent and very widespread; despite this, it cannot be solved either very easily or successfully. The academic literature, however, finds different effects of corruption on economic performance. Some studies describe how corruption „greases the wheels” of economy by overcoming bureaucratic constraints, inefficient provision of public services and rigid laws. Other studies argue that corruption only reduces economic performance. Based on the searches results of the theoretical literature and empirical studies, this contribution verifies the validity of hypotheses about the negative impact of corruption on economic growth of V4 countries in the period 1999 - 2015. The validity of the hypothesis of corruption’s negative influence was verified on a panel data sample. The validity of the hypothesis of corruption’s negative influence on economic growth for V4 countries was confirmed. Corruption negatively influences economic growth directly but also indirectly via transmission channels in V4 countries.*

**Keywords:** Corruption, economic growth, V4 countries, post-communist countries.

**JEL Classification:** D73, O11, P27

## **1 Introduction**

For decades, the phenomenon of corruption is the subject of many theoretical and empirical studies, while at the issue receives much attention in the present. Professional literature presents mixed evidence about its impact on economic growth. Some authors consider corruption as a "driving force" of the economy, but others argue that it acts as imaginary "sand in the wheels". Corruption, unfortunately, accompanied and deeply scars also economic transformation of post-communist countries and proved to be one of the most serious problems of the so-called transition economies. Corruption as one of the main problems of the institutional environment in transition economies and the fight against corruption has become closely studied criterion for entry of these countries into the European Union. The very process of accession into the European Union significantly and positively influenced the building of anti-corruption policy, the implementation of anti-corruption mechanisms and creating a transparent economic environment.

The goal of this paper is to verify the validity the hypothesis that corruption negatively influences economic growth in the V4 countries. The analysis will focus on the verification of both the direct impact of corruption and indirect influence through a series of transmission channels.

## **2 Statement of the problem**

One of the most significant arguments in favour of corruption’s positive influence on economic growth was put forth by Leff (1964) and Huntington (1968) in the 1970’s. According to them, corruption has the ability to hasten lengthy and ineffective administrative processes. For this reason, they asserted it necessarily “greases the wheels” of the public administration’s performance (Hodge et al., 2011). On the other hand, Myrdal (1968) however disagrees because it could lead to even greater delay and further inefficiency on account of trying to attract a greater number of bribes or increase their costs.

In this connection, Tanzi (1998) argued that bribes increase companies’ start-up costs; moreover, these companies could have been able to use these funds in a more effective way. Other authors found that corruption is blocking innovation and development of these businesses and therefore undermines economic growth. It also prevents the development of a market economy and undermines the system of free markets, as it increases the level of uncertainty. In some areas, threatening the vital role of the state or impedes government intervention. It also leads to poor resource allocation, since the structure of public spending often turn to certain sectors, particularly those that have to do with corruption are more obvious opportunities (Dridi, 2013; Ionescu, 2014). Mauro (2002) based on his empirical studies have found that the greater likelihood of low economic growth and widespread corruption are countries for which is characterized by low productivity and large public sectors. More recent empirical studies indicate that the impact of corruption on economic growth cannot be explained without taking into account the institutional frameworks of each country.

In examining the relationship between corruption and economic growth, the number of authors has come to the conclusion that the significant impact of corruption on economic growth tends to disappear when other important determinants of economic growth are integrated (e.g. Aisen & Veiga, 2013; Farrag & Ezzat, 2016; Dridi, 2013). This suggests that a significant portion of the effect, which impairs economic growth, is transmitted indirectly via the main determinants of growth, which are also referred to as transformation or transmission channels. As the most important transmission channels are designated by investments, human capital and political instability.

### 3 Material and Methods

The validity of the hypothesis of corruption's negative influence was verified on a panel data sample in the program Gretl. Due to the attributes of panel data, the estimation of the model's parameters was conducted using a fixed effects model. This choice was supported by rejecting the null hypothesis of Hausman test, which recommended the use of fixed effects model as an appropriate method for estimations.

A fixed effects model uses dummy variables to model individual effects. This regression has a great many explanatory variables, but it is still a regression model. For this reason, all the truths relating to regression models and equations are also valid here (1):

$$Y_{it} = \alpha_N D_{it}^{(N)} + \beta X_{it} + \epsilon_{it} \quad (1)$$

This model assumes the heterogeneity of the cross-sectional units in total members; therefore, it is necessary for the fixed effects model to create  $N$  various dummy variables, which are shown as  $D^{(j)}$ , where  $j = 1, \dots, N$ .

It is necessary to verify and evaluate the estimated econometric model before applying it. The traditional set of preconditions that econometrics considers in the context of regression error, i.e., error terms ( $\epsilon_i$ ), is used here and is expressed in the following way (Freund, Mohr, Wilson, 2010, Baltagi, 2015):

- $E(\epsilon_i) = 0$ . A zero means value of the error term.
- $var(\epsilon_i) = E(\epsilon_i^2) = \sigma^2$ . Constant variance of error (homoscedasticity)
- $cov(\epsilon_i; \epsilon_j) = 0$  for  $i \neq j$ . The error terms are not correlated.
- $\epsilon_i$  has normal distribution.
- $X_i$  is fixed; therefore, it is not a random value.

The significance level set for the analysis is the standard, 0.05.

### 4 Analysis of the impact of corruption on economic growth of V4 countries

As was mentioned in the introduction, the goal of this paper is to verify the validity of the hypothesis of corruption's negative influence on economic growth. The analysis was conducted on the group of V4 countries. For this reason, a description of the current state of corruption in the selected group of countries is included in the content of this paper.

#### 4.1 The current state of corruption in the V4 countries

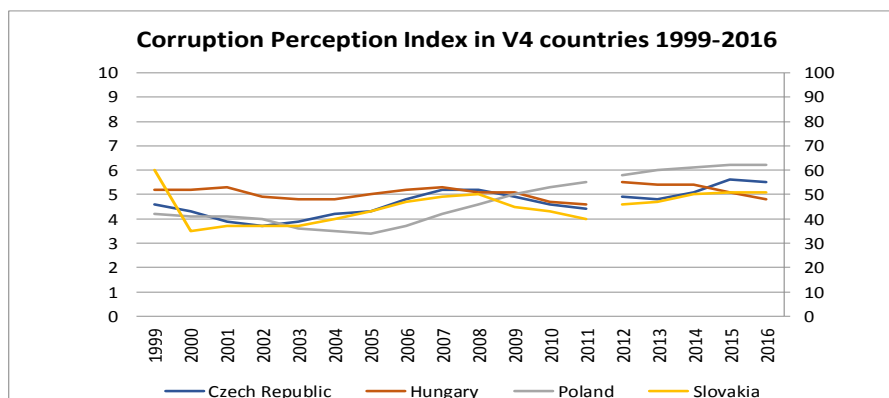
There are many causes of corruption and its spread in the countries. The political changes in some countries weakened social, political and legal institutions and opened the way to new opportunities, including those of corruption. Elsewhere, political and economic liberalization simply revealed the corrupt practices that were previously hidden. In post-communist and transition economies social system instability has become a breeding ground for corruption. The transformation period is mainly due to the spillover of corrupt practices in the field of trade and service and public administration. In these economies simultaneously acts legacy of communism, which affects corruption as an accompanying phenomenon of transformation processes. The issue of corruption is for those reasons perceived as a serious problem and especially post-communist transition economies, among which include the Visegrad states (Linhartová & Volejníková, 2013; Blagojević & Damijan, 2013).

Evaluation of the V4 countries according to the Corruption Perception Index (CPI) is shown by Figure 1. CPI is annually published by Transparency International and takes values in the interval from 0 to 100, where 0 is a highly corrupt country and a value of 100 indicates a country without corruption.<sup>1</sup> Though the CPI assesses the

<sup>1</sup> Note: CPI was evaluated on a scale of 0-10 until 2011. Despite these changes which complicate a year-to-year data comparison, the CPI's ranking of countries (as opposed to individual scores) remains a useful tool and benchmark for comparison of individual countries within V4 group.

level of perceived corruption, not the real level of corruption, the results received a lot of international attention. This is due to its wide-ranging in number compared countries and long time series.

**Figure 1** - Evaluation of the V4 countries according to the Corruption Perception Index 1999-2016. Source: Transparency International.



Corruption as one of the major problems of the institutional environment of former socialist economies and the fight against corruption had become a sharply monitored criterion for the entry of the V4 countries into the EU. At the beginning of the period, Czech Republic, Slovak Republic and Poland had very low values for CPI. Significantly better values of CPI were reached before joining the EU, except Hungary. After 2004, after the V4 had joined the European Union, all countries had a significant increase of the CPI (with the exception of Poland, for which it improved a year later). This improvement in the evaluation of the perception of corruption in the countries can certainly be attributed to the newly adopted legislation in the context of harmonization of law with European Union governments to develop strategies for combating corruption and increasing media coverage of this issue. In the coming years, the Visegrad states with a gradual improvement in the perception of corruption expects to breaking point year in 2008. From this year showed all the Visegrad states except Poland negative trend. A significant role in the perception of corruption could play in this period of economic crisis, the impact of which can negatively affect also in public opinion.

For increased attention by the development in the CPI in Poland, while in 2004, Poland had fallen behind. Considerably better assessment of Hungary put the country in the last position within the countries of the V4 group. The countries of the V4 group achieved in 2010 the best results in the observed group of countries and have retained this position to this day. Perception of corruption as a major threat is rather stabilized, which might be related to the de-politicization of the corruption topic. The current PO administration ('Platforma Obywatelska' or Civic Platform) claims that its implementation of the anti-corruption strategy goes well despite some delays. It would appear that the Polish authorities take the issue of corruption prevention in respect of Members of Parliament, judges and prosecutors seriously and should be commended for this.

Czech Republic in the final rating of 2015 significantly improved its position and can be described as "Jumper of the Year" 2015. The Czech Republic reached in the evaluation of CPI in 2015 the best result in the last twenty years. According to the Czech branch of Transparency International (2015), in recent years in the Czech Republic a series of repressive measures aimed at eliminating opportunities for corruption has been taken. For instance, the personal and systemic changes in the state prosecutor's office after 2012, breaking a series of client-list system, the introduction of new anti-corruption mechanisms in the segments of the private sector and pressure on legislative and systemic changes initiated platform Reconstruction of the state.

#### 4.2 Model formulation and variable specification

The hypothesis about the negative impact of corruption in the country has been tested with the help of the econometric model assembled using the method with fixed effects in the Gretl program for the V4 countries in the years 1999-2015. The model's specifications were derived from the empirical work of authors dealing with the identification of the transmission channels via which corruption influences economic growth. On the basis of these studies, the author of this paper assumed that corruption influences economic growth directly as well as indirectly via transmission channels. These transmission channels are considered to be investment, human capital, political instability, government expenses, and trade openness. Household expenditure, one of the basic components determining gross domestic product, included in the model along with these transmission channels, which are also determinants of economic growth. After testing the variables' stationarity, the model was constructed as follows (2):

$$GDP\_Growth_{it} = \beta_0 + \beta_1 CPI\_Growth_{it} + \beta_2 HOUExp\_Growth_{it} + \beta_3 INV\_Growth_{it} + \beta_4 GOVexp\_Growth_{it} + \beta_5 d\_NX_{it} + \beta_6 HC\_Growth_{it} + \beta_7 d\_PS_{it} \quad (2)$$

A description of the individual variables is presented in Table 1.

**Table 1** - Description of the Variables Used

Variable	Description of the Variable	Units	Positive/Negative
<i>i</i>	Respective country		
<i>t</i>	Respective year		
<i>GDP_Growth</i>	Gross domestic product <sup>2</sup>	Growth in %	
<i>CPI_Growth</i>	Corruption Perceptions Index	Growth in %	Positive
<i>HOUExp_Growth</i>	Household consumption	Growth in %	Positive
<i>INV_Growth</i>	Investment <sup>3</sup>	Growth in %	Positive
<i>GOVexp_Growth</i>	Government expenditure	Growth in %	Positive
<i>d_NX</i>	Balance of international trade	Total change	Positive
<i>HC_Growth</i>	Human capital <sup>4</sup>	Growth in %	Positive
<i>d_PS</i>	Political Stability Index	Total change	Positive

#### 4.2.1 Testing the hypothesis of corruption's direct influence on economic growth

The first part of the analysis validates the hypothesis of a direct negative impact of corruption on economic growth. In the event that through analysis demonstrated a positive effect of one determinant (except CPI) on economic growth, as in other parts of the hypothesis will be tested by the indirect negative impact of corruption on economic growth. The estimation of the parameters according to the model constructed above is presented in Table 2. The model explains 72% of the variability of the *GDP* response variable ( $R^2 = 0.72$ ). For the variable of *CPI*, it was not possible to demonstrate statistical significance; also, the opposite effect than that which was assumed when specifying the variables was demonstrated. The coefficient for the variable *GOVexp*, which appeared as statistically significant, was shown to be negative. Statistical significance was not proved for either the variable *HC* or *NX*.

**Table 2** - Estimation of the Parameters of All the Explanatory Variables

	Coefficient	Std. Error	t-ratio	p-value	
<b>const</b>	-0,465905	0,781981	-0,5958	0,5554	
<b>CPI_Growth</b>	-0,0637808	0,0571406	-1,116	0,2724	
<b>HOUExp_Growth</b>	0,706213	0,151111	4,673	4,81e-05	***
<b>INV_Growth</b>	0,124396	0,0458892	2,711	0,0106	**
<b>GOVexp_Growth</b>	-0,139269	0,0596572	-2,334	0,0258	**
<b>HC_Growth</b>	-0,00164874	0,00528940	-0,3117	0,7555	
<b>d_NX</b>	9,78100e-05	0,000101186	0,9666	0,3408	
<b>d_PS</b>	6,08533	2,13863	2,845	0,0076	***

Because of marked differences between the assumptions and results of this analysis, the model was tested after removing the statistically insignificant variables (with the exception of the *CPI* variable). The test results are shown in Table 3. This model explains 69% of variation explained variables *GDP* ( $R^2 = 0.69$ ). After subsequent removal of the statistically insignificant variables *NX* and *HC*, the *CPI* variable's trajectory of influence on economic growth changed direction. After more detailed investigation, it was determined that the *CPI* variable is negative only when the *PS* variable is included in the model. Moreover, after eliminating these variables, the *CPI* variable's statistical significance increased and became statistically significant. No significant changes occurred for the other variables' coefficients.

**Table 3** - Estimation of the Parameters of Selected Explanatory Variables

<sup>2</sup> Real gross domestic product.

<sup>3</sup> Expressed using gross fixed capital formation as an indicator.

<sup>4</sup> Expressed using the number of students enrolled in secondary education as an indicator.

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
<b>const</b>	0,351083	0,637107	0,5511	0,5848	
<b>CPI_Growth</b>	0,0484305	0,0450301	2,4093	0,06826	*
<b>HOUExp_Growth</b>	0,582769	0,135245	4,309	0,0001	***
<b>INV_Growth</b>	0,136558	0,0439758	3,105	0,0036	***
<b>GOVexp_Growth</b>	-0,141222	0,0584659	-2,415	0,0206	**
<b>d_PS</b>	4,89991	1,90361	2,574	0,0141	**

Regarding the fact that the *CPI* variable showed low statistical significance in the previous models and had an ambiguous effect on the response variable, the possibility of it having a delayed effect on the response variable was thus verified. It is important to note that the delay was added only for the *CPI* variable, and not for the other basic components determining *GDP*, because the paper's author did not assume that these determinants would influence the response variable with a time delay. Variables that did not show statistical significance in the previous models (*HC*, *NX*) were not included in the model. Length of the time delay is one year. The outputs of the model are shown in Table 4. The model explains 69% of variation explained variables *GDP* ( $R^2 = 0.69$ ). Variable *CPI* came out positive and statistically significant. This suggests that corruption has no adverse effects on economic growth only directly, but also with a time lag.

**Table 4** - Estimation of the Model Parameters with Time Delay

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
<b>Const</b>	0,362768	0,644090	0,5632	0,5766	**
<b>CPI_Growth_1</b>	0,0341281	0,0501686	2,4809	0,07333	*
<b>HOUExp_Growth</b>	0,547805	0,127411	4,300	0,0001	***
<b>INV_Growth</b>	0,127532	0,0429326	2,971	0,0051	***
<b>GOVexp_Growth</b>	-0,121723	0,0539763	-2,255	0,0300	**
<b>d_PS</b>	5,15831	1,97022	2,618	0,0126	**

#### 4.2.2 Testing the hypothesis of corruption's indirect influence on economic growth

It was demonstrated that the variables *HOUExp*, *INV* and *PS* had a positive influence on economic growth in the previous models. Here arises the question whether this could be related to the transmission channels via which corruption can also indirectly influence economic growth. For the purposes of verifying this hypothesis, three models were constructed using the response variables of *HOUExp*, *INV* a *PS*. In order for these response variables to be designated as transmission channels, the *CPI* variable must be positive. With regards to the variables' stationarity, the models were composed in the following way (3), (4), (5):

$$HOUExp\_Growth_{it} = \beta_0 + \beta_1 CPI\_Growth_{it} + \beta_2 GDP\_Growth_{it} + \beta_3 INV\_Growth_{it} + \beta_4 GOVexp\_Growth_{it} + \beta_5 d\_NX_{it} + \beta_6 HC\_Growth_{it} + \beta_7 d\_PS_{it} \quad (3)$$

$$INV\_Growth_{it} = \beta_0 + \beta_1 CPI\_Growth_{it} + \beta_2 GDP\_Growth_{it} + \beta_3 HOUExp\_Growth_{it} + \beta_4 GOVexp\_Growth_{it} + \beta_5 d\_NX_{it} + \beta_6 HC\_Growth_{it} + \beta_7 d\_PS_{it} \quad (4)$$

$$d\_PS_{it} = \beta_0 + \beta_1 CPI\_Growth_{it} + \beta_2 GDP\_Growth_{it} + \beta_3 HOUExp\_Growth_{it} + \beta_4 GOVexp\_Growth_{it} + \beta_5 INV\_Growth_{it} + \beta_6 d\_NX_{it} + \beta_7 HC\_Growth_{it} \quad (5)$$

The type of effect that the variable of *CPI* has on the variable of *HOUExp* was tested first. The results of this model are presented in Table 5. The model explains 67% of variability of the *HOUExp* response variable ( $R^2 = 0.67$ ). In this model, the *CPI* variable was statistical significance.

**Table 5** - Estimation of the Model Parameters for the *HOUExp* Variable

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
<b>const</b>	2,08187	0,530451	3,925	0,0004	***
<b>CPI_Growth</b>	0,147219	0,0489662	3,007	0,0047	***
<b>GDP_Growth</b>	0,563236	0,130711	4,309	0,0001	***
<b>INV_Growth</b>	-0,0876790	0,0462714	-1,895	0,0657	*

<b>GOVexp_Growth</b>	0,191378	0,0533583	3,587	0,0009	***
<b>d_NX</b>	-1,27377e-05	8,96502e-05	-0,1421	0,8878	
<b>HC_Growth</b>	-0,00326841	0,00582929	-0,5607	0,5755	
<b>d_PS</b>	-1,04450	2,02095	-0,5168	0,6083	

Investment was determined as the next possible transmission channel. Outputs of this model are presented in Table 6. The model explains 82 % of variability of the *INV* response variable ( $R^2 = 0,82$ ). The statistical significance of the CPI variables was successfully proven in this case.

**Table 6** - Estimation of the Model Parameters for the INV Variable

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
<b>const</b>	-0,664247	2,10455	-0,3156	0,7540	
<b>CPI_Growth</b>	0,316061	0,175221	1,804	0,0792	*
<b>GDP_Growth</b>	1,42429	0,213054	6,685	1,56e-010	***
<b>HOUSexp_Growth</b>	-0,984634	0,519628	-1,895	0,0657	*
<b>GOVexp_Growth</b>	1,02591	0,122881	8,349	4,00e-010	***
<b>d_NX</b>	-0,000531901	0,000287854	-1,848	0,0724	*
<b>HC_Growth</b>	0,0167781	0,0235055	0,7138	0,4804	
<b>d_PS</b>	-0,0788484	6,79618	-0,01160	0,9908	

The last response variable was the variable of *PS*. The results of these models are presented in Table 7. The model explains only 17 % of variability of the *PS* response variable ( $R^2 = 0,17$ ). In this case, it was not possible to demonstrate that the *CPI* variable was statistically significant, even though it showed positive influence on the *PS* response variable.

**Table 7** - Estimation of the Model Parameters for the PS Variable

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
<b>const</b>	-0,0650173	0,0491821	-1,322	0,1941	
<b>CPI_Growth</b>	0,000890734	0,00435541	0,2045	0,8390	
<b>GDP_Growth</b>	0,0303003	0,0117717	2,574	0,0141	**
<b>HOUSexp_Growth</b>	-0,00668303	0,0129306	-0,5168	0,6083	
<b>GOVexp_Growth</b>	-0,000218397	0,00493784	-0,04423	0,9650	
<b>INV_Growth</b>	-4,49240e-05	0,00387213	-0,01160	0,9908	
<b>d_NX</b>	-3,78983e-06	7,14658e-06	0,5303	0,5990	
<b>HC_Growth</b>	-0,00132941	0,000447273	-2,972	0,0055	***

## 5 Results and discussion

The results of the analysis show that corruption has really negative impact on economic growth, as in most of the estimated models CPI featured as positive moreover, statistically significant. It even showed statistical significance when a time delay of one year was built in for this variable.

Opposite direction of action and statistical insignificance was observed for this variable when the variable of NX is included in the model. This is most likely due to existing relationship between these two variables, although the diagnostic control model did not prove breach of classic assumptions. Many studies show that corruption is closely linked to foreign trade. Reputation of corrupt state may deter potential foreign importers. The exporter is not likely to do business with countries that strictly enforce many laws and unjustified regulation in order to obtain a bribe or with countries whose state institutions are very corrupt, and where very poor law enforcement exist.

The *GOVexp* variable demonstrated the opposite effect than that which was assumed when specifying the variables. According to the analysis, this variable has a negative influence on the *GDP* response variable in the selected group of countries, although it is one of GDP's basic components. However, government expenditure should be necessary for individual countries' economies, because it makes it possible to increase the levels of human and material capital, support technological advancement, and thus contribute to economic growth. Moreover, it also creates suitable conditions for private investment, e.g., in the form of investment incentives, etc. On the other hand, it depends on how effectively these funds are spent. The group of countries includes



those characterized by a great degree of reallocation and generous social support systems. Naturally, this also means that the populations of these countries pay high taxes. Because of this, individuals have lower motivation to work as well as a lesser tendency to invest, which undermines economic growth.

In the paper, the hypothesis on corruption's indirect negative influence on economic growth was also tested. The variables of *HOUExp*, *INV*, and *PS* appeared as potential transmission channels, because it was possible to show their statistical significance and positive influence on the *GDP* response variable in the previous models. The analysis confirms this assumption for variables *HOUExp* and *INV*. For this reason, it is possible to consider them transmission channels, through which corruption influences economic growth. This means that the decreasing value of the CPI (i.e. Increase the perception of corruption) reduces household consumption and corporate investments, which adversely affects gross domestic product. In the case of variable *PS*, it was not possible to prove that the hypothesis was valid.

Transmission channel in the form of household consumption could be associated with the inefficient management of the analyzed countries. As an example it is possible to mention the problem of public procurement, which are the most common areas of corruption on a global scale and that result in inefficient state economy and a waste of taxpayers' money. Due to this problem, national budgets show losses and it becomes necessary for countries to raise taxes, which leads to limiting household expenditure and hence lowering economic growth.

Also investment appears as another possible transmission channel in this analysis. Authors of the most empirical studies concluded that there is a negative relationship between corruption and investment because of uncertainty and heightened risk of failure because corruption agreements are unenforceable. There are also higher additional costs that must be spent on secretive corrupt activities. Conversely, the analysis shows that corruption has a positive influence on investment in the selected sample of countries, even though very insignificant. However, most of the authors of empirical studies have opined that a negative relationship between corruption and investment does exist on account of insecurity and increased danger of failure, because corrupt agreements are not enforceable. Supplemental costs for necessary expenditures to cover up corrupt activities also increase. However, it is also possible to find corruption's positive influence on investment. For example, the problem of public procurement can be mentioned once again. When public procurement is announced by the government, e.g., the construction of a new highway, a company can pay in order to be selected as the winning bidder. Once it becomes the winning bidder, it can invoice exorbitant prices or cut back on quality. In this case, the company profits from corruption and can further develop its investment activities.

## 6 Conclusion

In conclusion, it is possible to state that the validity of the hypothesis of corruption's negative influence on economic growth was confirmed for the V4 member countries. Higher level of perceived corruption in these countries brings reduction of their economic growth. At the same time, the analysis demonstrated that corruption effects economic growth not only directly but also with a time lag.

Through this analysis, however, it was also confirmed another statement of authors of empirical studies, that corruption's influence on economic growth becomes statistically less significant after incorporating other economic growth determinants. This indicated that corruption affects economic growth directly but also indirectly through these determinants. After testing this hypothesis, it was determined that corruption effects economic growth negatively via household expenditure and firms investment

The outputs of this article cannot be generalized to other countries or other periods of time, since the hypothesis of the error term's normal distribution was rejected. Thus, those conclusions can be applied only to a set of V4 member states in the years 1999-2015 time series.

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