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The Wagner's law testing in the Visegrád Four countries

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Abstract: This research paper analyses the relationship between gross domestic product and public expenditures in nominal terms. The analysis is being done by using the standard Peacock-Wiseman specification of the Wagner's law and provides the results for the Visegrád Four countries, i.e. the Czech Republic, Slovakia, Poland and Hungary. We aim to answer a question concerning the existence of a long and/or short-term relationship between the nominal GDP and nominal public expenditures, which consist of current and capital expenditures. To address this question, we employ the VAR model, the Johansen Cointegration test and the VEC model. We study a period between the first quarter of 1999 and the second quarter of 2019 and find out mixed results for the Visegrád Four countries.

Keywords: cointegration, economic growth, GDP, Keynesian hypothesis, public expenditures, Visegrád, Wagner's law

JEL Classification: C32, E60, H50

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Introduction

The relationship between public expenditures and gross domestic product (GDP) has been in the centre of interest of many economic theorists for about three centuries. First of all, in the 18th century, classical economists expected negative impact of public expenditures on gross domestic product. In the 19th century Adolph Wagner came up with an idea of positive relationship and was followed by John Maynard Keynes, who expected positive relationship as well, but in the opposite direction. The main reason for the increasing interest in this topic is probably the fact that the knowledge of the relationship between public expenditures and GDP is important for the public policymakers. The key question is whether there is empirical evidence of either the Keynesian hypothesis of exogenous public expenditures and the possibility to influence the GDP by using public expenditures as a tool, or it is empirically rather confirmed the Wagner's law of endogenous public expenditures.

The knowledge of this relationship is important especially for the fiscal policymakers and economists as when the relationship is positive and directed from public expenditures to GDP, it makes sense to improve the economic growth in the short run by using public expenditures. If the opposite is true, public expenditures are not an efficient policy tool, and the government should reduce unnecessary costs. So far, this relationship has been

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tested in several countries around the world, for various economic areas and in many modifications. However, this paper contributes to the current research as it investigates the relationship in the area of economically and historically close countries of the Visegrád Four (V4). All these countries at the turn of the 80s and 90s faced a transition to the market economy and had to overcome other obstacles connected to the phase of convergence to other European market economies. After the re-establishment of the cooperation in 1991, political leaders of the V4 countries above other goals *"wanted to overcome their communist heritage and artificial division of the European continent"*. (Visegradgroup.eu)

The main objective of this research is to study a long-term relationship between total public expenditures and GDP in nominal terms only to investigate the validity of the Wagner's law in the Visegrád Four countries, i.e. the Czech Republic, Slovakia, Poland and Hungary. The questions regarding the evaluation of the structure of public expenditures are beyond the scope of this research paper. For our research, we use the following econometric methods: stationarity tests to test whether the time series are time-dependent (non-stationary), the Vector Autoregression Model, the Johansen cointegration test and the Vector Error Correction Model to distinguish the long and the short-term relationship.

Section 1 provides a brief literature review of the current state of the art of this topic and the results of testing in selected economies. Section 2 reviews the empirical framework used for the testing of the relationship in this paper, the methodology used for the analysis and data. Section 3 presents and discusses the results of the analysis. Section 0 concludes.

1 Literature review and theoretical basis

The nature of the research question requires us to review some basic theoretical background behind the relationship between public expenditures and GDP. The relationship between those two variables is important especially for the public policymakers as it answers the question on whether it is possible to use the expansive public policy to influence the economic growth or to use public expenditures as a stabilizer without possible harmful effects to the economic growth.

The first publication that should be mentioned regarding public finance is the Wealth of Nations by the English economist Adam Smith written in 1776. His publication reacted especially to the Mercantilism and its view to the wealth and international trade. Smith believed that people promote public interest through economic choices and was the author of the designation "invisible hand" for a free-market force. Smith advocated "laissez-faire", a system in which private transactions are not regulated or otherwise influenced by the government. (Musgrave and Peacock, 1958) The government should hold only the following functions (Akrani, 2011): *defence against foreign aggression, maintenance of internal peace and order and work on public development*. Any other state activities were supposed to be useless and negatively influence economic growth. Based on these facts, public expenditures cannot be used as the fiscal policy tool to increase economic growth, and the relationship is thus rather negative.

1.1 The Wagner's law versus the Keynesian hypothesis

At the end of the 19th century, the German economist Adolph Wagner formulated *the law of the increasing state activity* known as the Wagner's law. Based on his findings, the relationship between public expenditures and GDP is positive and directed from GDP to public expenditures. The law *postulates that as real income increases, there is a long-run tendency for the share of public expenditures to increase relative to national income*. (Magazzino et al., 2015) Wagner also provided the explanations to his findings (Pistoresi et al., 2017). First of all, *the increasing complexity of the economy requires higher government intervention. The industrialization and urbanization requires government regulation and higher expenditures on contractual enforcement and ensuring law and order. Next reason is the supposed higher income elasticity of publicly provided goods and services and the need to finance large-scale investments with public good characteristics.* The increase of public expenditures results from the social, technological and economic development of the economy.

The research on the relationship between public expenditures and GDP also continued in the 20th century. After the Great Depression, there was a need to find a tool or a mechanism to recover the economies and secure them against the repetition of the crises. The solution was provided by John Maynard Keynes in the publication The General Theory of Employment, Interest and Money in 1936. His publication generally meant a revolution in economic thinking since it contradicted the ideas of neoclassical economics in many aspects. As well as Wagner, Keynes supposes a positive relationship between public expenditures and GDP, but in a direction from the public expenditures to GDP. This is also known as the Keynesian hypothesis. Based on these findings, it is possible to use public expenditures as a fiscal policy tool and improve the economic growth in a downturn. On the other hand, in an upturn, public expenditures should be lower to cancel out the deficit by surplus. Thus, the behaviour should be intentionally counter-cyclical. (Musgrave and Peacock, 1958)

According to the Wagner's law, public expenditures are an endogenous variable that is influenced by GDP. Contrary to that, by the Keynesian hypothesis, public expenditures are an exogenous variable that can be used as a tool to improve economic growth. (Tang, 2009)

The Keynesian hypothesis is being explained by the AS-AD model. As it is a short-term concept, an aggregate supply curve is relatively flat (elasticity is higher than 1). An increase in public expenditures leads to the shift of an aggregate demand to the right, which causes an increase in GDP and prices to extend based on the actual supply curve elasticity (depending on the domination of the multiplier or the crowding-out effects). This hypothesis is though based on the assumption that the economy is in the long-term below its production potential.

The Wagner's law is, on the other hand, a long-term concept where the aggregate supply is inelastic (elasticity is lower than 1). Based on this, an increase in public expenditures shifts the aggregate demand to the right with a small or no effect on the GDP. The increase in GDP (aggregate supply, i.e. the capacity of the economy) leads to an increase of the aggregate demand (consumption, investment, net exports and public expenditures). Private spending increases as the economic agents use part of the additional income for consumption. Those processes lead to an increase in prices.

1.2 The Peacock-Wiseman hypothesis

Alan T. Peacock and Jack Wiseman (Gemmel, 1993) published in 1961 a monograph The Growth of Public Expenditures in the United Kingdom where they studied the growth of public expenditures in the United Kingdom between 1881 and 1955. Their findings confirmed the validity of the Wagner's law. The authors further studied the pattern of the increase of public expenditures and identified the so-called "displacement effect" of household expenditures by public expenditures. They noticed that government spending tends to evolve in a step-like pattern that coincides with social upheavals and wars. The explanation of this phenomenon is as follows. In the peaceful times, the government is unable to increase taxes; thus the increase of public expenditures to GDP is slower compared to the periods of wars and preparation for war periods. The increase of public expenditures before and during the war is connected to the increase of the taxes that at least partly covers these expenditures. After the war, the citizens got used to the level of the taxes paid during the war. As they are grateful for the peace and wish the peace to be maintained in the future, the level of the taxes remains the same and does not decrease to the pre-war levels. The higher tolerance of the citizens to the taxes enables the government to implement the expenditure programs that would not be possible to implement before the war. On the other hand, household expenditures decrease as the taxes increases, i.e. are displaced by public expenditures.

Peacock and Wiseman thus disclosed another explanation of why public sector expenditures increase with the growth of the economy. The development of the size of public sector experiences jumps in the war and social upheaval periods and those periods cause that the general ("neutral") level of public sector expenditures moves up relative to the pre-war level as the households get used to the new level of the taxes. In the war period, GDP generally decreases but public sector expenditures increase due to armament. On the other hand, from the history we know that wars were the source of innovations and the after-war development was connected with higher economic growth.

1.3 The Wagner's law testing: State of the art

The first testing of the Wagner's law was done by Adolph Wagner, who tested the existence of a long-term relationship between real public expenditures and real GDP in a direction from GDP to public expenditures for Germany and then for other European countries. Based on the results of this analysis, Wagner formulated in 1883 the so-called Wagner's law.

The Wagner's law has been further tested by many other authors in different countries, and several different specifications of the relationship have been used. (Andrei, 2009; Richter, 2012) Currently, there are 6 possible variants of the Law available for testing (see below), where G, C, GDP and N denote public expenditures, consumption, gross domestic product and population. Researchers usually use the logarithmic transformation of data as the estimated coefficients express elasticities. Using this transformation, it is directly known that the Wagner's law holds if the elasticity is greater than 1 for the specification 1 – 4 and if the elasticity is greater than 0 for specification 5 and 6. However, the first testing by Wagner was done by using real terms, we can find publications using both real and nominal terms (e.g. Kuckuck, 2012).

1. **Peacock-Wiseman** in 1967: This specification estimates the elasticity of public expenditures wrt. GDP.

$$lnG_t = \alpha_1 + \beta_1 lnGDP_t + \varepsilon_{1t} \quad (1)$$

2. **Pryor** in 1968: This specification estimates the elasticity of consumption wrt. GDP.

$$lnC_t = \alpha_1 + \beta_1 lnGDP_t + \varepsilon_{2t} \quad (2)$$

3. **Gupta** in 1967: This specification estimates the elasticity of public expenditures per capita wrt. GDP per capita (N).

$$ln(G/N)_t = \alpha_1 + \beta_1 ln(GDP/N)_t + \varepsilon_{3t} \quad (3)$$

4. **Goffman** in 1968: Another variant estimates the elasticity of public expenditures wrt. GDP per capita.

$$lnG_t = \alpha_1 + \beta_1 ln(GDP/N)_t + \varepsilon_{4t} \quad (4)$$

5. **Musgrave** in 1969: This specification estimates the elasticity of the ratio of public expenditures to GDP wrt. GDP per capita.

$$ln(G/GDP)_t = \alpha_1 + \beta_1 ln(GDP/N)_t + \varepsilon_{5t} \quad (5)$$

6. **Mann** in 1980: The last specification estimates the elasticity of the ratio of public expenditures to GDP wrt. GDP.

$$ln(G/GDP)_t = \alpha_1 + \beta_1 lnGDP_t + \varepsilon_{6t} \quad (6)$$

The validity of the Wagner's law has been tested in several countries around the world. We choose a set of studies for reference.

Gatsi et al. (2019) test the Wagner's law validity for Ghana in the period between 1960 and 2017. For this purpose, the authors use the Johansen cointegration method, ADL model bound test and Toda-Yamamoto non-Granger causality test. The results confirm the existence of cointegration, but there is no Granger causality from real economic growth to public expenditures; thus, the Wagner's law does not hold, and public expenditures are an exogenous factor. Abbasov et al. (2018) test the validity of the Wagner's law and the Keynesian hypothesis in nine post-soviet countries, i.e. Estonia, Latvia, Lithuania, Uzbekistan, Azerbaijan, Georgia, the Kyrgyz Republic, Moldova and Ukraine, and investigate the long and short-term relationship between real per capita GDP and real per capita public expenditures. The authors use the ADL model, the Error Correction Model and a causality test. The results confirm a bi-directional short-term relationship for all countries in the sample except for Lithuania and the Kyrgyz Republic. A long-term relationship confirming the Wagner's law is found for Latvia, Lithuania, Uzbekistan, Georgia, the Kyrgyz Republic and Ukraine. A long-term relationship in the Keynesian hypothesis sense is found for Estonia, Uzbekistan, Azerbaijan, Kyrgyz Republic and Moldova. Ali et al. (2016) study the Wagner's law and the Keynesian hypothesis validity for aggregate expenditures as well as for individual components of expenditures in Pakistan. The authors use the Engle and Granger (1987) two-step procedure and the Granger causality test for time series from 1976 to 2015. Only social, economic and education services have long-run association with GDP. Based on the causality tests, the Wagner's law is confirmed for expenditures on current subsidies, expenditures on defence, current expenditures and expenditures on development. The Keynesian hypothesis is confirmed for expenditures on social, economic and education services. Masan (2015) studies the Wagner's law and the Keynesian hypothesis validity by using the aggregated as well as disaggregated expenditures in Oman from 1980 to 2005. He uses the Engle and Granger two-step cointegration and Granger causality techniques embodied in the Error Correction Model. The author tests the relationship both in real and nominal terms. The paper supports short-term unidirectional causality from GDP to various specifications of public expenditures for both real and nominal terms. The Keynesian hypothesis is rejected in the long and short-term for both real and nominal variables. Bayrak et al. (2014) analyse the validity of the Wagner's law in 27 OECD countries between 1995 and 2012. The authors use the unit-root co-integration and error correction tests on a panel data. The empirical results confirm the presence of a long and short-term relationship between public expenditure and economic growth. Based on their findings, the growth performance stimulates the growth in public expenditure. Bojanic (2013) studies the Wagner's law for Bolivia in the period from 1940 to 2010 by using nine empirical specifications, where he tests among the above-mentioned specifications the relationship between GDP and individual components of public expenditures, i.e. education, infrastructure, health and defence. The author uses the cointegration test proposed by Johansen in 1988 and Johansen with Juselius in 1990, for causality testing he applies the Error Correction Model and the standard Granger causality test in cases where the cointegration was not identified. Based on the analysis, the bi-directional relationship is identified in six out of nine specifications (incl. the disaggregated components of public expenditures). However, the causality from the economic growth to public expenditures is stronger to the opposite one. The author further discusses the negative consequences of public policies on economic growth and emphasizes a need for supervision over the allocation of public finances to services. Lamartina et al. (2011) analyse the validity of the Wagner's law in 23 OECD countries between 1970 and 2007. The authors use standard methods like the unit-root test and cointegration test on panel data. The results confirm the validity of the Law. Further, the authors found that the correlation is higher for countries with lower per-capita GDP. Pohlavani et al. (2011) study the validity of the Wagner's law for Iran from 1960 to 2008. The authors use a cointegration test proposed by Pesaran et al. in 2001 and Granger causality tests based on the Error Correction Model (ECM). The results are further confirmed by a causality test proposed by Toda and Yamamoto in 1995. The authors study the relationship between GDP and share of total expenditures in GDP. Their findings confirm the hypothesis of the Wagner's law validity; thus, there is a long-term relationship from the economic growth to the size of government. The Keynesian hypothesis is not confirmed; thus, the growth of public expenditures is not efficient in supporting economic growth.

Some of the mentioned publications test the validity using both total expenditures and components of the expenditures. The increase in some components of public expenditures can be well explained by the Baumol's effect (the Baumol's cost disease). The Baumol's effect explains *the rise of salaries in jobs that have experienced no or low increase in labour productivity, in response to rising salaries in other jobs that have experienced higher labour productivity growth*.

Another area regarding the Wagner's law testing that deserves further research is a dependency of the results on the level of economic development. This area may be interesting for our sample as the V4 countries went through different phases of their development and economic transformation in the studied period that could have influenced the results of our analysis. This area was studied by e.g. Kuckuck (2012) or Wu et al. (2010).

Kuckuck (2012) tests the validity of the Wagner's law depending on the level of economic development in the period from the 2nd half of 19th century to the present for Great Britain, Denmark, Sweden, Finland and Italy. The testing is done by using standard methods, i.e. stationarity tests, cointegration and causality for three individual phases of economic development based on the World Bank's income definitions. The author tests 3 specifications of the Wagner's law, i.e. Peacock and Wiseman (1961), Goffman (1968) and Gupta (1967). For all the countries except Denmark, the cointegration relationship is confirmed for all three phases of economic development. For Denmark, the cointegration relationship is confirmed only for the second and third phase and for the first phase the relationship is not found significant. The assumption that with the rising economic development, the significance of causal relationship from GDP to public expenditures decreases is confirmed for Great Britain, Denmark, Finland and Sweden. With higher economic development, public expenditures do not react to GDP growth as sensitive as in the lower phases. The results for Italy are different as in the first and second phase confirm rather the Keynesian hypothesis, and in the last phase, confirm a bidirectional relationship.

2 Empirical Framework

In the next part, we study the long and short-term relationship between nominal GDP and nominal public expenditures consisting of current and capital expenditures (based on ESA2010). For this purpose, we follow the standard procedure where we test the stationarity of the time series, further, we construct VAR model, test cointegration (if the time series are integrated I(1), they probably are co-integrated) and construct the VEC model to distinguish short and long-term relationships. Sections 2.1 – 2.2 describe the methodology and data.

2.1 Methodology

For the Wagner's law validity testing, we use the Peacock and Wiseman specification (see in 1.3). Based on the theory and empirical specification, the elasticity of public expenditures to GDP should be higher to 1. To test the Keynesian hypothesis validity, we use the same empirical specification but interpret it in the opposite direction (from public expenditures to GDP) whereas the elasticity should be higher to 0 to ensure the positive effect of public expenditures on GDP. As the elasticities are estimated, the logarithmically transformed time series are used[2]. This can be written in the following form, where *y* and *x* are the logarithmically transformed *GDP* and *GOV*.

$$x_t = \alpha_1 + \beta_1 y_t + \varepsilon_{1t} \quad (7)$$

First of all, we have to study the order of integration of the time series, i.e. stationarity, and for this purpose, we use the Augmented Dickey-Fuller (ADF; Dickey, Fuller, 1979) test and the Phillips-Perron test. If both time series are integrated of order I(1), we have to study the co-integration, i.e. a long-term common movement of both time series. We expect that there is a bidirectional relationship between the variables that is confirmed

[2] Another reason for the logarithmic transformation is that economic time series are log-normally distributed thus their logarithmic transformation has normal distribution.

both by the theory and empirical evidence, hence for this analysis, we use the Vector Autoregression Model (Arlt, Arltová, 2009). We specify the model lags based on the VAR lag order selection criteria and the residual diagnostics. The VAR model can be generally written as follows:

$$x_t = \eta + \sum_{i=1}^{p} \varrho_i x_{t-i} + \sum_{j=0}^{q} \psi_j y_{t-q} + \upsilon_t \quad (8)$$

$$y_t = \delta + \sum_{i=1}^{p} \theta_i y_{t-i} + \sum_{j=0}^{q} \phi_j x_{t-q} + \lambda_t \quad (9)$$

Further, we test the cointegration of the time series in the model using the Johansen Cointegration test (Greene, 2003) and decide on the deterministic trend assumption. To make the final decision on the theory validity, we have to construct the Vector Error Correction Model (VECM) that is defined as follows:

$$\Delta x_t = f_t{'}\rho + \sum_{i=1}^{p-1} \eta_i \Delta x_{t-i} + \sum_{i=1}^{p-1} \chi_i \Delta y_{t-i} + \gamma_1 (x_{t-1} - \beta_1 y_{t-1} - \alpha_1) + \varsigma_t \quad (10)$$

$$\Delta y_t = f_t{'}\pi + \sum_{i=1}^{p-1} \varphi_i \Delta y_{t-i} + \sum_{i=1}^{p-1} \kappa_i \Delta x_{t-i} + \epsilon_1 \left(y_{t-1} - \frac{1}{\beta_1} x_{t-1} - \alpha_1 \right) + \tau_t \quad (11)$$

The Vector Error Correction model enables us to distinguish the long and short-term relationships in the model. The representation describes the variation in either *x* or *y* around their long-term trend in terms of a set of exogenous factors ($\boldsymbol{f_t}$), the variation of lagged endogenous variables (*x* and *y*) and the error correction in the parenthesis. In this specification, we can decide if there is a long-term relationship based on the statistical significance of γ_1 and ϵ_1, and if there is a short-term relationship based on the statistical significance of κ_i and χ_i. The first one we test by the test of weak exogeneity imposing restrictions to the VEC model, for the second we use the Wald test. The results of these tests are in the Annexe.

2.2 Data

We used the data from the European Central Bank data warehouse database for a period from 1999Q1 to 2019Q2, together 82 quarters. The period from 1999 to 2019 was interrupted by the Global Financial Crises approximately in the half of the time series. This and other parts of data interrupted by the external shocks that could have influenced the results were eliminated using dummy variables based on residual graphs.

The data for all countries have a seasonal component. Therefore we test seasonality in the time series and adjust them for seasonality using Census X13 methodology (U.S. Census Bureau, 2013). The seasonally adjusted time series can be seen in Graphs 1–4 The analysis has been done using econometrical software Eviews 11.

Public expenditures (see Graph 1) were larger in Q1 and Q3 of 2003 which disrupt the otherwise smooth development of the series. The higher expenditures were the consequence of pre-election promises in the first year of an election cycle (see it in Czech NERV, 2009). Further, we may consider smoothing the disruption caused by the Global financial crisis at the end of 2008 and beginning of 2009. In the GDP series, we can see the Global financial crises impact at the end of 2008.

The GDP series of Hungary (see Graph 2) was negatively influenced by the Global financial crisis around the end of 2008 as well. We may face the problem with the

Johansen Cointegration test result as there may be a structural break in the data. Further, in the GOV series, several unexplained jumps have not been smoothed by the seasonal adjustment.

The time series for Poland (see Graph 3) do not include any important disruptions, but the final decision on the possible dummy variables inclusion will be based on a residual graph.

The series for Slovakia (see Graph 4) are problematic for more reasons. First, GDP is negatively influenced by the Global financial crises, hence it may need smoothing. Further, more importantly, the time series for GDP behaves differently after 2009. The difference in behaviour is probably caused by joining the euro area and transfer to the euro currency from Slovak Crown since 2009. This fact may cause a structural break in the relationship and a failure of the Johansen Cointegration test in defining the number of cointegrating vectors.

Further, we test the unit roots in the time series using the Augmented Dickey-Fuller test and Phillips-Perron test. The results, including specification, are in Table 1. From the results, we can see that all the time series are non-stationary and integrated of order 1 and their first differences integrated of order 0.

Table 1: Unit Root Test of the seasonally adjusted logarithmically transformed time series and of their first differences

ADF test

I/1999 - II/2019	Seasonally Adj. Time Series			Seasonally Adj. Time Series			First Differences		
	Specification	t_{ADF}	Prob.	Specification	t_{ADF}	Prob.	Specification	t_{ADF}	Prob.
$LGDP^{CZ}$	I	-1.169	0.684	I, T	-1.578	0.793	I	-6.088	0.000
$LGOV^{CZ}$	I	-1.823	0.367	I, T	-2.974	0.146	I	-9.702	0.000
$LGDP^{HU}$	I	-0.789	0.817	I, T	-1.580	0.793	I	-5.247	0.000
$LGOV^{HU}$	I	-2.839	0.058	I, T	-2.332	0.412	I	-9.100	0.000
$LGDP^{PL}$	I	-0.271	0.924	I, T	-1.948	0.620	I	-10.476	0.000
$LGOV^{PL}$	I	-1.659	0.448	I, T	-1.914	0.638	I	-10.352	0.000
$LGDP^{SK}$	I	-2.990	0.040	I, T	-0.918	0.948	I	-3.987	0.002
$LGOV^{SK}$	I	-1.439	0.559	I, T	-2.558	0.300	I	-10.753	0.000

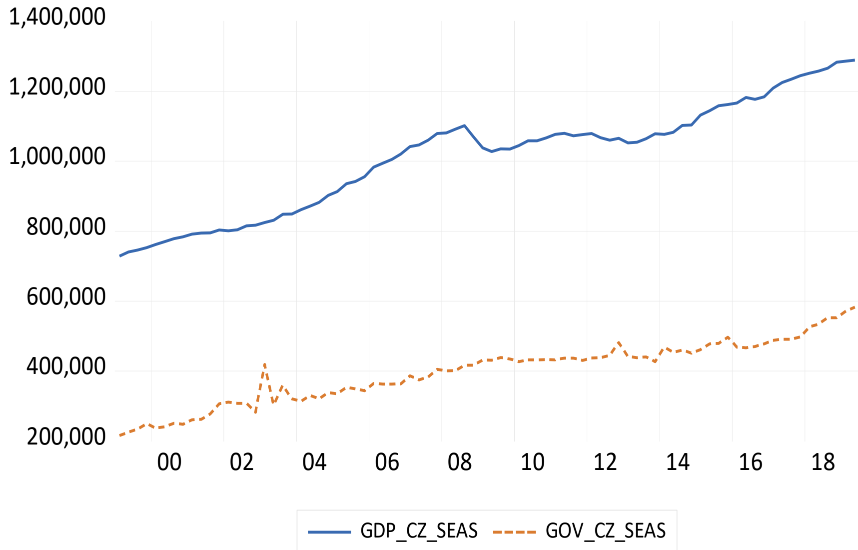
Phillips-Perron test

I/1999 - II/2019	Seasonally Adj. Time Series			Seasonally Adj. Time Series			First Differences		
	Specification	t_{PP}	Prob.	Specification	t_{PP}	Prob.	Specification	t_{PP}	Prob.
$LGDP^{CZ}$	I	-1.324	0.615	I, T	-1.721	0.733	I	-6.287	0.000
$LGOV^{CZ}$	I	-1.851	0.354	I, T	-4.815	0.001	I	-22.569	0.000
$LGDP^{HU}$	I	-1.144	0.695	I, T	-1.781	0.705	I	-5.275	0.000
$LGOV^{HU}$	I	-2.730	0.073	I, T	-2.404	0.375	I	-14.920	0.000
$LGDP^{PL}$	I	-0.269	0.924	I, T	-2.080	0.549	I	-10.294	0.000
$LGOV^{PL}$	I	-1.895	0.333	I, T	-1.840	0.676	I	-10.611	0.000
$LGDP^{SK}$	I	-2.592	0.099	I, T	-0.508	0.981	I	-5.994	0.000
$LGOV^{SK}$	I	-1.651	0.452	I, T	-2.976	0.146	I	-11.091	0.000

Source: Eviews, own calculations

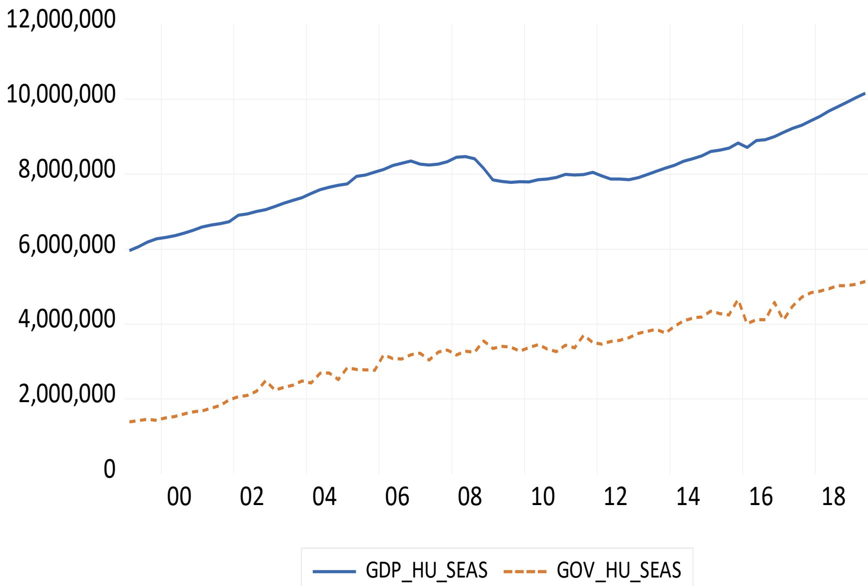
Note: I denotes intercept, T denotes trend. For data in levels, we test two specifications as we would like to know the source of the non-stationarity (whether it is a stochastic or deterministic trend).

Graph 1: Seasonally Adjusted Time Series – Czech Republic (in CZK mil)



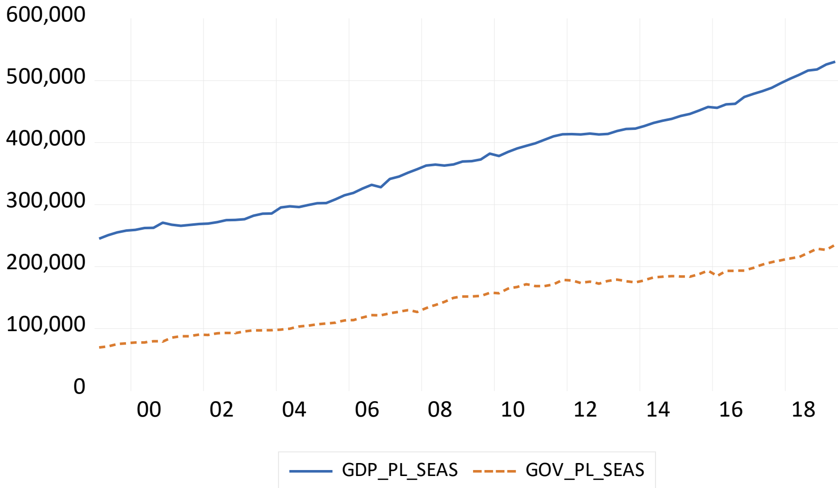
Source: own calculation

Graph 2: Seasonally Adjusted Time Series – Hungary (in HUF mil)



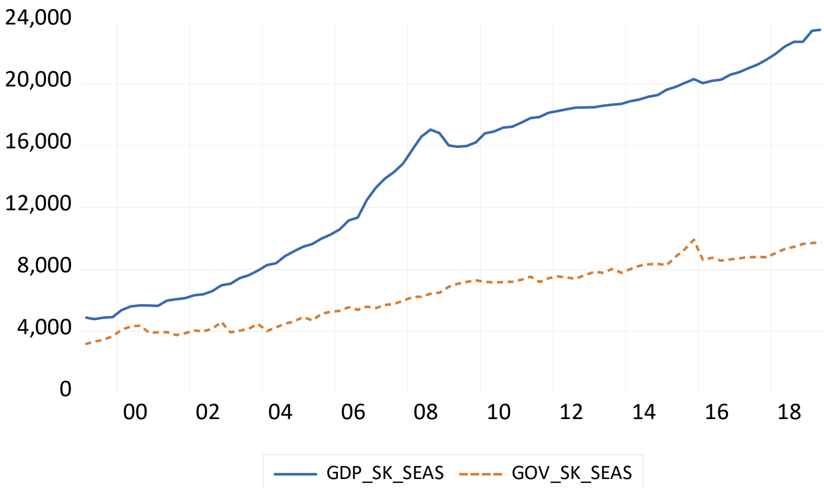
Source: own calculation

Graph 3: Seasonally Adjusted Time Series – Poland (in PLN mil)



Source: own calculation

Graph 4: Seasonally Adjusted Time Series – Slovakia (in EUR mil)



Source: own calculation

3 Empirical Results and Discussion

3.1 VEC model construction and results

In the first step, we construct the VAR model, test the appropriate number of lags and make the standard residual diagnostic (see in 0 Annexe for VAR models).

For the Czech Republic, the best model seems to be the VAR (4), whereas, based on the residual diagnostic tests, it is not necessary to include dummy variables. For Hungary, we include dummy variables $Dummy^{HU}_{GDP1}$ (Q4 2008) and $Dummy^{HU}_{GDP2}$ (Q1 2009) and based on residual diagnostic, we use the VAR (3). For Poland, we use $Dummy^{PL}_{GDP1}$ (Q1 2007) dummy variable and construct the VAR (2). Finally, for Slovakia, we use $Dummy^{SK}_{GOV1}$ (Q1 2003) dummy variable and construct the VAR (2).

Based on the Johansen test (see in 0 Annexe) we use deterministic trend specification with the intercept (no trend) in cointegrating equation (no trend in data) for all countries. For Slovakia, the result is complicated since it indicates for some specifications 2 cointegrating vectors, however, only 1 is possible. The reason might be the transfer to the euro currency (as already mentioned in 2.2 Data) in half of the studied series that causes structural break and failure of the test. A similar problem we can see for Hungary as well, but the reason might be the post-crisis downturn.

The final Vector Error Correction (VEC) models are in Table 2 – Table 5. We came through a full set of residual diagnostic tests with the result that the VEC models are diagnostically right (residual diagnostic could be provided by the author upon request).

The results for the Czech Republic (see Table 2) indicate the validity of the Wagner's law in the long-term and the Keynesian hypothesis only in the short-term (see the results of Wald test in Table 2, in the upper part of the grey area). The elasticity of the long-term relationship in Table 2 is larger to 1 for the Wagner's law (for the Keynesian hypothesis can be the elasticity easily derived as inverse value of the estimated coefficient), and the cointegrating equation (CointEq1) is statistically significant only in the direction of the Wagner's law (see the weak exogeneity test in Table 2, in the bottom part of the grey area).

The results for Hungary and Poland (Table 3 and Table 4) indicate the validity of the Wagner's law in the long-term and the Keynesian hypothesis in the long-term as well. Same as in the case of the Czech Republic the elasticity is larger to 1 thus the Wagner's law holds and the cointegrating equation is statistically significant in both directions (see the tests in the bottom part of the grey area in Table 3 and Table 4). Short-term relationships are not statistically significant (see the Wald test results in the upper part of the grey area in Table 4Table 3 and Table 4).

The results for Slovakia (Table 5) indicate the bi-directional statistically significant long-term relationship, but the elasticity in the Wagner's law direction is lower to 1 thus the Wagner's law does not hold, but the Keynesian hypothesis hold with the elasticity larger to 1. The cointegrating equation is statistically significant in both directions (see the tests in the bottom part of the grey area in Table 5). Short-term relationships are not statistically significant (see the Wald test results in the upper part of the grey area in Table 5).

There are significant similarities and differences among the countries. Analyses for Poland and Hungary have similar results, where the estimated elasticity is relatively high (its value for Poland is 1.42 and for Hungary is 1.86) although the loading coefficients[3] are in both cases relatively low (for Poland -0.05 in the Wagner's law sense and -0.009 in the Keynesian hypothesis sense and Hungary -0.06 in the Wagner's law sense and -

[3] Error correction coefficient of the speed of return to the long-term equilibrium.

0.04 in the Keynesian hypothesis sense). These coefficients mean the speed of adjustment to the long-term equilibrium and are very low but statistically significant. Based on the results, it is possible to support or stabilise the economy by using public expenditures as a tool, and the relationship is bi-directional thus public expenditures grow with the economic development.

The analysis for the Czech Republic shows that the long-term coefficient is lower compared to Poland and Hungary (its value is 1.29). Still, the loading coefficient is higher (its value is -0.30 in the Wagner's law sense but -0.04 in the Keynesian hypothesis sense) and statistically significant only in the Wagner's sense. Compared to the other countries in a sample, there is a significant short-term relationship in the Keynesian's sense; thus it is possible to support the economy in the downturn by using public expenditures as a tool or use it as a stabilizer.

The most different results we receive for Slovakia, where, however, we confirm the bi-directional relationship, the long-term coefficient is very low and thus not Wagnerian (its value is -0.44). The loading parameter is of similar height to Poland and Hungary and statistically significant. Table 2: Czech Republic – VEC (3)

Table 2: Czech Republic – VEC (3)

	$LGOV^{CZ}$(-1)	$LGDP^{CZ}$(-1)	C		CointEq1	d($LGOV^{CZ}$(-1))	d($LGOV^{CZ}$(-2))	d($LGOV^{CZ}$(-3))	d($LGDP^{CZ}$(-1))	d($LGDP^{CZ}$(-2))	d($LGDP^{CZ}$(-3))
				d($LGDP^{CZ}$)	-0.005	-0.021	0.028	-0.007	0.461	-0.055	0.346
					(0.015)	(0.019)	(0.023)	(0.020)	(0.117)	(0.127)	(0.121)
					[-0.310]	[-1.075]	[1.198]	[-0.332]	[3.940]	[-0.434]	[2.853]
Coint Eq1	1.000	-1.287	4.824	d($LGOV^{CZ}$)	-0.302	-0.641	-0.157	0.023	-0.577	-0.324	0.052
		(0.130)	(1.805)		(0.082)	(0.109)	(0.129)	(0.111)	(0.655)	(0.712)	(0.679)
		[-9.883]	[2.673]		[-3.661]	[-5.875]	[-1.211]	[0.212]	[-0.880]	[-0.455]	[0.077]

WALD test - coefficient restrictions

Coefficients c(5), c(6), c(7) are equal to 0 (lagged d(LGDP))

Test Statistic	Value	df	Probability
F-statistic	0.486	(3, 71)	0.693
Chi-square	1.457	3	0.692

Coefficients c(9), c(10), c(11) are equal to 0 (lagged d(LGOV))

Test Statistic	Value	df	Probability
F-statistic	2.897	(3, 71)	0.041
Chi-square	8.691	3	0.034

VEC restrictions - CointEg1 parameter test

Cointegration Restrictions: $LGOV^{CZ}$

A(1,1) = 0

Convergence achieved after 5 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	4.583
Probability	0.032

Cointegration Restrictions: $LGDP^{CZ}$

A(2,1) = 0

Convergence achieved after 5 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	0.038
Probability	0.845

Source: Eviews, own calculation

Table 3: Hungary – VEC (2)

	LGOV^{HU}(-1)	LGDP^{HU}(-1)	C		CointEq1	d(LGOV^{HU}(-1))	d(LGOV^{HU}(-2))	d(LGDP^{HU}(-1))	d(LGDP^{HU}(-2))	Dummy$^{HU}_{GDP1}$	Dummy$^{HU}_{GDP2}$
				d(LGDP^{HU})	-0.009	0.021	0.015	0.095	0.199	-0.035	-0.040
					(0.002)	(0.018)	(0.018)	(0.105)	(0.094)	(0.007)	(0.008)
					[-4.033]	[1.130]	[0.853]	[0.905]	[2.123]	[-4.903]	[-4.903]
Coint Eq1	**1.000**	**-1.862**	14.124	d(LGOV^{HU})	-0.054	-0.538	-0.272	-0.004	0.490	0.060	-0.032
		(0.649)	(10.314)		(0.013)	(0.112)	(0.109)	(0.643)	(0.573)	(0.044)	(0.050)
		[-2.870]	[1.369]		[-4.027]	[-4.800]	[-2.487]	[-0.007]	[0.856]	[1.366]	[-0.650]

WALD test - coefficient restrictions

Coefficients c(4), c(5) are equal to 0 (lagged d(LGDP))

Test Statistic	Value	df	Probability
F-statistic	0.440	(2, 72)	0.646
Chi-square	0.880	2	0.644

Coefficients c(9), c(10) are equal to 0 (lagged d(LGOV))

Test Statistic	Value	df	Probability
F-statistic	0.719	(2, 72)	0.491
Chi-square	1.438	2	0.487

VEC restrictions - CointEg1 parameter test

Cointegration Restrictions: LGOV^{HU}

A(1,1) = 0

Convergence achieved after 7 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	12.527
Probability	0.000

Cointegration Restrictions: LGDP^{HU}

A(2,1) = 0

Convergence achieved after 6 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	12.558
Probability	0.000

Table 4: Poland – VEC (1)

	LGOV^{PL}(-1)	LGDP^{PL}(-1)	C		CointEq1	d(LGOV^{PL}(-1))	d(LGDP^{PL}(-1))	Dummy$^{PL}_{GDP1}$
				d(LGDP^{PL})	-0.035	-0.028	-0.076	0.029
					(0.006)	(0.051)	(0.114)	(0.009)
					[-6.102]	[-0.554]	[-0.668]	[3.145]
Coint Eq1	**1.000**	**-1.426**	6.136	d(LGOV^{PL})	-0.064	-0.185	0.020	0.013
		(0.103)	(1.321)		(0.012)	(0.109)	(0.244)	(0.020)
		[-13.848]	[4.647]		[-5.195]	[-1.700]	[0.081]	[0.629]

WALD test - coefficient restrictions

Coefficients c(3) is equal to 0 (lagged d(LGDP))

Test Statistic	Value	df	Probability
F-statistic	0.007	(1, 76)	0.936
Chi-square	0.007	1	0.936

Coefficients c(6) is equal to 0 (lagged d(LGOV))

Test Statistic	Value	df	Probability
F-statistic	0.306	(1, 76)	0.582
Chi-square	0.306	1	0.580

VEC restrictions - CointEg1 parameter test

Cointegration Restrictions: LGOV^{PL}

A(1,1) = 0

Convergence achieved after 10 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	21.061
Probability	0.000

Cointegration Restrictions: LGDP^{PL}

A(2,1) = 0

Convergence achieved after 5 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	27.444
Probability	0.000

Source: Eviews, own calculation

Table 5: Slovakia – VEC (1)

	$LGOV^{SK}(-1)$	$LGDP^{SK}(-1)$	C		CointEq1	$d(LGOV^{SK}(-1))$	$d(LGDP^{SK}(-1))$	$Dummy^{SK}_{GOV1}$
				$d(LGDP^{SK})$	-0.068	0.019	0.286	-0.017
					(0.013)	(0.050)	(0.109)	(0.020)
					[-5.310]	[0.387]	[2.630]	[-0.865]
Coint Eq1	**1.000**	**-0.437**	-4.802	$d(LGOV^{SK})$	-0.112	-0.047	-0.312	-0.162
		(0.059)	(0.565)		(0.026)	(0.102)	(0.220)	(0.040)
		[-7.418]	[-8.492]		[-4.331]	[-0.459]	[-1.421]	[-4.044]

WALD test - coefficient restrictions

Coefficients c(3) is equal to 0 (lagged d(LGDP))

Test Statistic	Value	df	Probability
F-statistic	2.020	(1, 76)	0.159
Chi-square	2.020	1	0.155

Coefficients c(6) is equal to 0 (lagged d(LGOV))

Test Statistic	Value	df	Probability
F-statistic	0.150	(1, 76)	0.700
Chi-square	0.150	1	0.700

VEC restrictions - CointEg1 parameter test

Cointegration Restrictions: $LGOV^{SK}$

A(1,1) = 0

Convergence achieved after 7 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	15.654
Probability	0.000

Cointegration Restrictions: $LGDP^{SK}$

A(2,1) = 0

Convergence achieved after 6 iterations.

Not all cointegrating vectors are identified LR test for binding restrictions (rank = 1):

Chi-square(1)	22.269
Probability	0.000

Source: Eviews, own calculation

Note: For each variable, Eviews reports the estimated coefficient, its standards error, and the t-statistic.

3.2 Discussion on the results and empirical estimation

The results of the literature review are ambiguous as some publications confirmed the Wagner's law and other not or only in some phases of economic development. Our results on a sample of countries confirm this fact and go in line with the current research. However, it contributes to the research as the analysis is made on the sample of a group of historically and economically connected countries; thus, similar results may have been expected. During the analysis, we found out several problems that may be present also in other publications already published. In the following paragraphs, we briefly discuss these problems.

The estimations could probably suffer from the omitted variable bias. The absence of other explanatory variables is addressed by many authors. For example, Maggazzino (2010) constructs standard and augmented version where he uses public deficit as the additional explanatory variable. Based on his findings and findings of the other authors he mentions in the literature review, omitted variables may mask or overstate the long-run linkages between economic development and public spending. This issue may be solved by controlling for other drivers of public expenditures. There is a long line of research on the determinants of public expenditures, but only a few are relatively new.

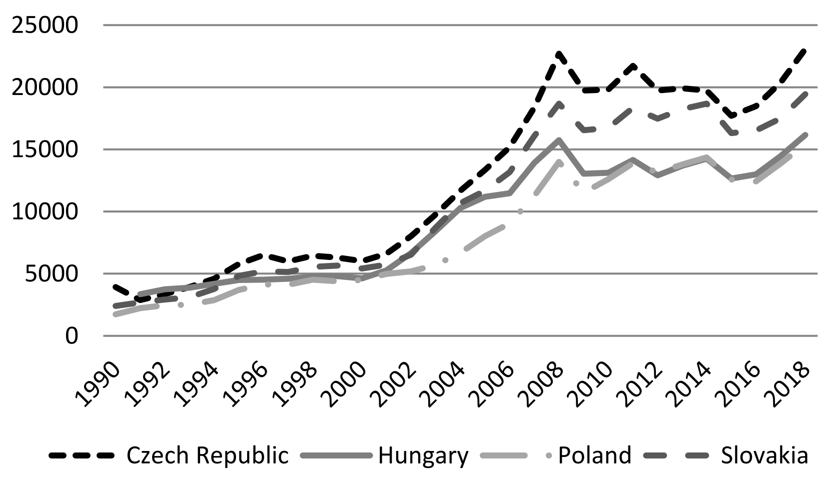
The size of government is generally determined by the demand side (preferences of citizens) and the supply side (the power of politicians) and constitutional design as mentioned in Facchini (2018). Among the most often used determinants from the demand side belong for example oil revenue, GDP, population, trade openness, oil price, taxation and inflation in the publication of Jibir et al. (2019) who studied the determinants of public expenditure in Nigeria. In the study of Sanz et al. (2002) on the sample of OECD countries, the authors found that besides income and prices, institutional factors, population density and its age structure are significant determinants of public expenditure.

Another problem that we do not directly take into account in the empirical analysis is the possible presence of structural breaks and its effect on the results. We mentioned this problem in the text above for Slovakia and Hungary. We apply the CUSUM stability test for all the estimated models, the results could be provided by the author upon request. For all the countries in the sample, the cointegrating relationship is stable and develops within the 5% interval of significance. However, our further research will be focused on removing doubts on this issue.

Further, we use only one specification of the Wagner's law testing. We do not regard the population growth, which may influence the estimation results in the following way. As the GDP per capita is a measure of a level of development, with the growth of this measure the Wagner's law holds if the ratio of public expenditures to GDP increases. As we can see in Graph 5, GDP per capita increased in all the countries. From the previous analysis, we further know that the ratio of public expenditures to GDP increases for all the countries except Slovakia.

The precise answer to this and other above-mentioned questions and problems would require another analysis that is beyond the scope of this research paper.

Graph 5: GDP per capita (current US$)



Source: World Bank national accounts data, and OECD National Accounts data files.

The limitations of this exercise discussed in this section form the author's further research intends, therefore the following research will be focused mainly on two areas. First of all, the model will be augmented by other determinants to deal with the omitted variable bias. The second area will focus on the investigation of whether the assumption that the validity of the Wagner's law depends on the level of economic development of a country. Re-estimation of the augmented model and investigation of the determinants in different phases of economic development may be useful for the full understanding of the development of public expenditures.

4 Conclusion

In section 1.3 are mentioned several studies dedicated to the Wagner's law testing. In most of the studied countries, the Wagner's law was confirmed in the entire or at least part of the studied period. In some cases, the bi-directional relationship was found as well, thus both the Wagner's law and the Keynesian hypothesis held. Section 3.1 was dedicated to the analysis of the validity of long-term relationship in the sense of the Wagner's law and the Keynesian hypothesis in the V4 countries. The results support the validity of the Wagner's law in all the countries except Slovakia. In Slovakia, there is a long-run bi-directional relationship but not in the Wagnerian sense. One of the reasons for the result confirming the Wagner's law in 3 out of 4 countries may be in the Baumol effect, described at the end of section 1.3. This may be the reason for an increase of expenditures on health, justice, culture, defence or education in response to an increase in wages in a private sector. This effect may be dominant in the converging economies.

The opinion of the economists on the increase of public expenditures in developed countries is conflicting. Some economists believe that large government intervention leads to lower economic growth, higher unemployment, and lowers efficiency. On the other hand, other economists believe that higher public expenditures contribute to the social development. In the opinion of the author, it is necessary to find the optimal trade-off between the public and private supply of services and goods, which highly depends on the level of institutional development of a country and mentality of citizens. Further, it is necessary to supervise the allocation of public finances that should be efficient and bring the maximum benefits to the public.

Based on the analysis, the author found several weaknesses in the approach that are mentioned in Section 3.2. These problems will be the basis for further research of the author who intends to enhance the analysis and study the different components of public expenditures, their determinants and relationship to the economic development.

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References

ABBASOV, J. A., ALIYEV, K. (2018). Testing Wagner's Law and Keynesian Hypothesis in Selected Post-Soviet Countries. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 66(5), 1227-1237. DOI: 10.11118/actaun201866051227.

AKRANI, G. (2011). *Wagner Law of Increasing State Activity - Public Expenditures*. Retrieved 2019-06-12 from: https://kalyan-city.blogspot.com/2011/02/wagner-law-of-increasing-state-activity.html

ANDREI, T., STANCU, S., IACOB, A. I., HERTELIU, C. (2009). *Testing Wagner's Law for Romania*. Retrieved 2019-06-12 from: www.eco.u-szeged.hu/download.php?docID=40380

ARLT, J., ARLTOVÁ, M. (2009). *Ekonomické časové řady*. Praha: Professional Publishing. ISBN 978-80-86946-85-6.

BAYRAK, M., ESEN, Ö., GYAN, J. A., MCMILLAN, D. (2014). Examining the Validity of Wagner's Law in the OECD Economies. *Research in Applied Economics*, 6(3), 1-16. DOI: 10.5296/rae.v6i3.5354.

BILGILI, F. (1998). *Stationarity and cointegration tests: Comparison of Engle-Granger and Johansen Methodologies.* MPRA Paper No. 75967. Retrieved 2019-10-30 from: https://mpra.ub.uni-muenchen.de/75967/1/MPRA_paper_75967.pdf

BOJANIC, A. N. (2013). Testing the Validity of Wagner's Law in Bolivia: A Cointegration and Causality Analysis with Disaggregated Data. *Revista de análisis económico, 28(1),* 25-45. DOI: 10.4067/S0718-88702013000100002

DICKEY, D. A., FULLER, W. A. (1979). Distribution of Estimators for Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association*, 74(366), 427–431. DOI: 10.2307/2286348

FACCHINI, F. (2018). What Are the Determinants of Public Spending? An Overview of the Literature. *Atlantic Economic Journal*, 46(4), 419-439. DOI: 10.1007/s11293-018-9603-9.

GATSI, J. G., APPIAH, M. O., GYAN, J. A., MCMILLAN, D. (2019). A test of Wagner's hypothesis for the Ghanaian economy. *Atlantic Economic Journal*, 6(1), 419-439. DOI: 10.1080/23311975.2019.1647773.

Gemmell, N. (1993). *The growth of the public sector: Theories and international evidence, edited by Norman Gemmell.* Cheltenham: Edward Elgar Publishing. ISBN: 978 1 85278 525 3.

GREENE, W. (2003). *Econometric Analysis*. 5th ed. Upper Saddle River, N.J.: Prentice Hall, 2003. ISBN 0-13-066189-9.

JIBIR, A., ALUTHGE, C., ERCOLANO, S. (2019). Modelling the determinants of government expenditure in Nigeria. *Atlantic Economic Journal*, 7(1), 419-439. DOI: 10.1080/23322039.2019.1620154.

KUCKUCK, J. (2012). *Testing Wagners's Law at Different Stages of Economic Development A Historical Analysis of Five Western European Countries*. IEER Working Papers 91, Institute of Empirical Economic Research, Osnabrueck University. Retrieved 2019-06-18 from: https://ideas.repec.org/p/iee/wpaper/wp0091.html

LAMARTINA, S., ZAGHINI, A., GYAN, J. A., MCMILLAN, D. (2011). Increasing Public Expenditure: Wagner's Law in OECD Countries. *German Economic Review*, 12(2), 149-164. DOI: 10.1111/j.1468-0475.2010.00517.x. ISSN 1468-0475.

MAGAZZINO, C., GIOLLI, L., MELE, M. (2015). Wagner's Law and Peacock and Wiseman's Displacement Effect in European Union Countries: A Panel Data Study. *International journal of economics and financial issues*, 5(3), 812-819. ISSN: 2146-4138

MAGAZZINO, C. (2010). *Wagner's Law and Augmented Wagner's Law in EU-27. A Time-Series Analysis on Stationarity, Cointegration and Causality*. MPRA Paper No. 26668. Retrieved 2020-01-26 from: https://core.ac.uk/download/pdf/6564538.pdf

MASAN, S. S. (2015). *Testing Keynesian versus Wagner Hypothesis on the linkage between Government Spending and Economic Growth in Oman.* Proceedings of the Fourth Asia-Pacific Conference on Global Business, Economics, Finance and Social Sciences (AP15Malaysia Conference). Retrieved 2019-11-02 from: https://pdfs.semanticscholar.org/827b/d36c7af90889bf3b311d3fd8851b14ababd8.pdf

MUSGRAVE, R. A., PEACOCK, A. T. (1958). *Classics in the Theory of Public Finance*. London: Palgrave Macmillan. ISBN: 978-1-349-23426-4

Národní ekonomická rada vlády: Závěrečná zpráva (2009). National economic council (NERV). Retrieved 2019-12-08 from: https://www.vlada.cz/assets/media-centrum/dulezite-dokumenty/zaverecna-zprava-NERV.pdf

PAHLAVANI, M., ABED, D., POURSHABI, F. (2011). Investigating the Keynesian View and Wagner's Law on the Size of Government and Economic Growth in Iran. *International Journal of Business and Social Science*, 2(13), 170-175.

PISTORESI, B., RINALDI, A., SALSANO, F. (2017). Government spending and its components in Italy, 1862–2009: Drivers and policy implications. *Journal of Policy Modeling* 39(6), 1117-1140. DOI: 10.1016/j.jpolmod.2017.05.003

RICHTER, C., DIMITRIOS, P. (2012). *The Validity of Wagner's Law in the United Kingdom for the period 1850-2010*. INFER Working Papers 2012.9. Retrieved 2019-06-17 from: https://repository.uel.ac.uk/item/85y74

SANZ, I., VELÁZQUEZ, F. (2002). *Determinants of the Composition of Government Expenditure by Functions.* European Economy Group Working Papers 13, European Economy Group. Retrieved 2020-08-20 from: https://ecopub10.webs.ull.es/ponencias/ilusion.pdf

TANG, T. C. (2009). *Wagner's Law versus Keynesian Hypothesis in Malaysia: An Impressionistic View*. Monash Economics Working Papers 21-09, Monash University, Department of Economics. Retrieved 2019-06-12 from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.526.5919&rep=rep1&type=pdf

U.S. Census Bureau (2013). X-13-ARIMA. Washington, DC: U.S. Census Bureau, U.S. Department of Commerce.

WAJID, A., MUNIR, K. (2016). *Testing Wagner versus Keynesian Hypothesis for Pakistan: The Role of Aggregate and Disaggregate Expenditures*. MPRA Paper No. 74570. Retrieved 2019-11-02 from: https://mpra.ub.uni-muenchen.de/74570/1/MPRA_paper_74570.pdf

WU, S.-Y., TANG, J.-H., LIN, E. S. (2010). The impact of public expenditures on economic growth: How sensitive to the level of development? *Journal of Policy Modeling*, Elsevier, 32(6), 804-817. DOI: 10.1016/j.jpolmod.2010.05.011

Appendix – Empirical results

VAR models

Table 6. Czech Republic – VAR (4)

	$LGOV^{CZ}$ (-1)	$LGOV^{CZ}$ (-2)	$LGOV^{CZ}$ (-3)	$LGOV^{CZ}$ (-4)	$LGDP^{CZ}$ (-1)	$LGDP^{CZ}$ (-2)	$LGDP^{CZ}$ (-3)	$LGDP^{CZ}$ (-4)	C	Adj. R-Squared	F-Stat.	Prob. (F-Stat.)	DW stat.
$LGDP^{CZ}$	-0.024	0.051	-0.020	0.023	1.372	-0.488	0.431	-0.364	0.301	0.997	2848.373	0.000	1.958
	(0.020)	(0.020)	(0.020)	(0.020)	(0.113)	(0.192)	(0.191)	(0.116)	(0.148)				
	[-1.174]	[2.509]	[-1.001]	[1.166]	[12.184]	[-2.539]	[2.254]	[-3.128]	[2.032]				
$LGOV^{CZ}$	0.057	0.484	0.176	0.029	0.157	0.244	0.366	0.046	1.562	0.945	165.139	0.000	1.941
	(0.121)	(0.120)	(0.119)	(0.117)	(0.668)	(1.140)	(1.134)	(0.690)	(0.879)				
	[0.471]	[4.037]	[1.471]	[-0.247]	[-0.235]	[0.214]	[0.323]	[-0.067]	[-1.777]				

Source: Eviews, own calculation
Note: Residual diagnostics tests results could be provided by the author upon request.

Table 7. Hungary – VAR (3)

	$LGOV^{HU}$ (-1)	$LGOV^{HU}$ (-2)	$LGOV^{HU}$ (-3)	$LGDP^{HU}$ (-1)	$LGDP^{HU}$ (-2)	$LGDP^{HU}$ (-3)	C	Dummy $^{HU}_{GDP1}$	Dummy $^{HU}_{GDP2}$	Adj. R-Squared	F-Stat.	Prob. (F-Stat.)	DW stat.
$LGDP^{HU}$	0.016	-0.004	-0.015	1.097	0.120	0.210	-0.073	-0.035	-0.040	0.996	2468.712	0.000	2.092
	(0.019)	(0.019)	(0.018)	(0.104)	(0.168)	(0.097)	(0.287)	(0.007)	(0.008)				
	[0.856]	[-0.218]	[-0.835]	[10.517]	[0.717]	[-2.168]	[-0.255]	[-4.823]	[-4.937]				
$LGOV^{HU}$	0.379	0.259	0.272	0.183	0.392	-0.421	-1.080	0.061	-0.027	0.945	541.110	0.000	2.080
	(0.118)	(0.119)	(0.111)	(0.639)	(1.028)	(0.593)	(1.758)	(0.045)	(0.050)				
	[3.220]	[2.177]	[2.439]	[0.287]	[0.382]	[-0.710]	[-0.614]	[1.354]	[-0.547]				

Source: Eviews, own calculation
Note: Residual diagnostics tests results could be provided by the author upon request.

Table 8. Poland – VAR (2)

	$LGOV^{PL}$(-1)	$LGOV^{PL}$(-2)	$LGDP^{PL}$(-1)	$LGDP^{PL}$(-2)	C	Dummy $^{PL}_{GDP1}$	Adj. R-Squared	F-Stat.	Prob. (F-Stat.)	DW stat.
$LGDP^{PL}$	-0.042	0.038	0.943	0.064	-0.029	0.029	0.998	9696.971	0.000	2.095
	(0.055)	(0.052)	(0.110)	(0.115)	(0.178)	(0.009)				
	[-0.773]	[0.721]	[8.569]	[0.559]	[-0.165]	[3.092]				
$LGOV^{PL}$	0.698	0.161	0.189	0.011	-0.867	0.014	0.997	4894.910	0.000	2.001
	(0.116)	(0.111)	(0.234)	(0.244)	(0.378)	(0.020)				
	[6.006]	[1.455]	[0.809]	[0.044]	[-2.293]	[0.705]				

Source: Eviews, own calculation
Note: Residual diagnostics tests results could be provided by the author upon request.

Table 9. Slovakia – VAR (2)

	$LGOV^{SK}$(-1)	$LGOV^{SK}$(-2)	$LGDP^{SK}$(-1)	$LGDP^{SK}$(-2)	C	Dummy $^{SK}_{GOV1}$	Adj. R-Squared	F-Stat.	Prob. (F-Stat.)	DW stat.
$LGDP^{SK}$	-0.035	-0.008	1.304	-0.292	0.271	-0.020	0.998	9906.573	0.000	2.036
	(0.054)	(0.053)	(0.107)	(0.110)	(0.101)	(0.020)				
	[-0.645]	[-0.144]	[12.196]	[-2.655]	[2.693]	[-0.995]				
$LGOV^{SK}$	0.801	0.012	-0.231	0.331	0.697	-0.154	0.985	1024.479	0.000	2.048
	(0.108)	(0.106)	(0.215)	(0.221)	(0.202)	(0.041)				
	[7.446]	[0.117]	[-1.074]	[1.497]	[3.446]	[-3.767]				

Source: Eviews, own calculation
Note: Residual diagnostics tests results could be provided by the author upon request.

Table 10. Johansen Cointegration Test Summary for all countries

Czech Republic: Johansen Cointegration Test Summary
Lags interval: 1 to 4
Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	0	0	0
Max-Eig	1	1	0	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Hungary: Johansen Cointegration Test Summary
Lags interval: 1 to 3
Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	1	0	0	0
Max-Eig	2	1	0	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Poland: Johansen Cointegration Test Summary
Lags interval: 1 to 2
Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	0	0	0
Max-Eig	1	1	0	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Slovakia Johansen Cointegration Test Summary
Lags interval: 1 to 2
Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	1	1	0
Max-Eig	1	1	1	1	0

*Critical values based on MacKinnon-Haug-Michelis (1999)
Source: Eviews, own calculations