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The Impact of Public Expenditures on Economic Growth: A Case Study of Central and Eastern European Countries

Abstract: *This study tests the importance of various categories of public expenditure, the functional structure, and growth in the gross domestic product (GDP), using an autoregressive-distributed lag (ARDL) model. We document and study the correlation between real GDP growth and ten different categories of public expenditure, according to their functional classification, using quarterly data for the period 1995-2015, for ten selected Central and Eastern European countries that joined the European Union. The results of our study, like most recent literature, show that expenditures on education and health care has a positive impact on the economy, while expenditures on defense, economic affairs, general public services, and social welfare has a negative impact.*

Keywords: ARDL model, economic growth, public expenditure.

JEL: C30, E60, H50, O40.

1. Introduction

Since the 1990s, the process of economic integration has led to the adoption of some common budgetary rules, in both Western European countries and the formerly communist countries in Central and Eastern Europe (CEE) that joined the European Union, through the Maastricht treaty and the Stability and Growth Pact, which led to convergence in its evolution and size.

The CEE countries inherited public spending levels that by the 1990s exceeded 70% of the gross domestic product (GDP) but subsequently fell to Western European levels of 30-40% of GDP. However, past practices in the allocation of public expenditures in different economic sectors remained. Using the autoregressive-distributed lag (ARDL) model, our paper aims to analyze whether the allocation of public expenditure in CEE countries is economically efficient.

Budgetary allocations in different fields of activity, without prior serious analysis, may lead to economic distortions, with serious repercussions for future growth.

The relationship between the structure of public expenditure and economic growth, although important from a practical standpoint, has rarely been studied in the literature, except for some studies on public consumption (Barro and Sala-i-Martin, 1992), current expenditure and capital (Devarajan et al., 1996), and expenditure on education and health care (Poot, 2000). After the 2000s, many studies analyze these issues, in both developed and developing countries, such as Agénor (2010), Barro and Sala-i-Martin (2004), Benos and Zotou (2014), Bose et al. (2007), Colombier (2011), Ghosh and Gregoriou (2008), and Gupta et al. (2005).

According to the theory of endogenous growth, market failure can be overcome through government allocations, leading to increases in productivity for private factors of production and the accumulation of physical and human capital (Fournier and Johansson, 2016).

The state has several instruments at its disposal for stimulating the real economy. First, it can use direct financing or investment when the public sector provides the needed funds for infrastructure projects, primary education, and health care. Second, the state effectively provides some public services that are necessary for ensuring the basic conditions for economic activity and long-term investment (thus minimizing the cost of achieving a given amount of goods and services). Third, the state funds its own activities to minimize distortions related to savings behavior and private sector investment (Moruzumi and Veiga, 2016). Theory and recent empirical research demonstrate that the structure of spending, according to functional classification, provides a clearer picture of how the state can intervene to foster the development of the real economy.

The goal of this study is to investigate the relationship between the composition of public spending (Classification of the Functions of Government [COFOG]) and economic growth in CEE countries. Thus the uniqueness of this study implies testing for the existence or nonexistence of this possible relationship, in ten ex-communist CEE countries that joined the European Union (EU) (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and

Slovenia). This group of states was selected based on their having a common communist past and present EU membership, which implies economic harmonization and, at least in part, common public policies. Their EU membership includes a commitment to having a public sector with a similar proportion of national income. The period of our analysis is 1995-2015, using Eurostat quarterly time series.

The paradigm for determining the size and composition of public spending by European states has experienced a radical change, in the sense of transforming from free manifestation to the concept "quality of public finances" (Barrios and Schaechter, 2008). European institutions encourage member countries to increase their so-called productive spending (education, research and development, public investment) and decrease nonproductive expenditures in order to change the composition of public expenditure and arrive at an optimal common level in all member states. Our study analyzes whether the CEE countries have achieved these European standards. We identify whether specific categories of public spending are productive or unproductive and how they can influence the course of the economy and, implicitly, whether reallocation among different sectors is necessary.

Our study contributes to the literature in the following ways. First, the research idea is novel, as this is the first paper to analyze the relationship between the composition of public spending and economic growth in ten CEE states, from the perspective of possible correlation among the variables under consideration. To our knowledge, this relation has not been studied for the selected countries before now, and the literature focuses solely on developed economies.

Second, the paper tests an ARDL model, which is a method for analyzing the relationship among certain variables. Using this method, we obtained valid cointegration relations for eight out of the ten CEE countries studied. In the long term, we may look for demonstrating a relatively balanced relationship between public spending and economic growth.

Third, the paper concludes that some categories of public spending influence economic growth in eight of the ten countries: Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Romania, Slovakia, and Slovenia. In these countries, a range of types of government expenditures might enhance growth, which means that the governments of these countries should make the necessary corrections in order to attain economic efficiency in public spending.

The paper is organized as follows: Section 1 introduces existing studies in the literature; section 2 describes the methodology used in the study; section 3 discusses our empirical results; and section 4 outlines our conclusions.

2. Literature review

Theory and recent empirical research show that, rather than the overall level of spending, it is the structure of expenditures, based on their functional classifications, that presents a clearer picture of how the state can act to foster economic growth and development. Existing empirical studies on the relationship between the structure of public expenditure and economic growth focus mostly on two aspects: a division of public expenditure into productive and nonproductive and an analysis of determining factors in so-called productive expenditure. The research methodology used in the studies on productive expenditure implies an analysis of cross-country or panel-data types, which suffers from a lack of heterogeneity in the information provided. Barro and Sala-i-Martin (1992) develop the theory of endogenous growth, which includes public expenditure. They conclude that government consumption has a negative impact on long-term growth, whereas public investment has a positive impact. Cullison (1993) analyzes the relationship between the structure of public expenditure and economic growth in the United States for the period 1952-1991 and finds a positive correlation between economic growth and public expenditure on education, justice, and social security. Devarajan et al. (1996) use data on 43 countries for the period 1970-1990 and conclude that a change in the share of public expenditure (the ratio of total spending) has positive effects on the rate of economic growth whereas other expenses (capital expenses, defense, and economic infrastructure) have a negative impact on long-term economic growth.

Using a sample of 26 member countries in the Organization for Economic Cooperation and Development (OECD) for the period 1970-1997, Sanz and Velázquez (2001) develop a series of models based on public choice, in order to establish which factors affect each component of government expenses. The authors conclude that, unlike income and prices, institutional factors, population density, and a country's age structure have significant effects on the structure of government expenses.

Nijkamp and Poot (2004) study the interaction between government policies (general government consumption, tax rates, spending on education, defense, and public infrastructure) and economic growth; they conclude that only expenditures on infrastructure and education have a significant and positive impact on economic growth.

López and Miller (2007), using a sample of 29 countries that are ranked according to GDP per capita for the period 1980-2004, show that a permanent increase of 10% in government spending could immediately increase the growth rate per capita from 2.2% to 2.9%.

Another method used to analyze the impact of changing the structure of expenditure is time-series analysis. This method can give the most predictive results when applied to single countries, but not groups of countries.

Ramirez (2004) analyzes Mexico during the period 1955-1999 and, using the Cobb-Douglas production function and a vector error correction model (VECM), concludes that public expenditure on infrastructure—that is, transportation, communications, water, and sewage—as well as public expenditure on education and health care, positively affect economic growth.

Colombier (2011) studies Switzerland in his paper on the impact of the structure of public expenditure on economic growth. The data are analyzed for the period 1950-2004, with the author finding that spending on education and transportation is significantly correlated with GDP and has a positive impact on economic growth.

Focusing on Italy over the period 1990-2010, Magazzino (2011) uses Granger causality and the cointegration approach to explore whether eight of the ten categories of expenditure in the COFOG affect GDP growth, whether positively or negatively. His results are confirmed by the findings of other researchers: Lamartina and Zaghini (2011), Matins and Vega (2014), and Singh and

Weber (1997). In varying degrees, this topic has also been researched by Afonso and Fuceri (2010), Bayraktar and Moreno Dodson (2012), Brückner et al. (2012), Creedy et al. (2011), Lopez and Miller (2007), Miyakoshi et al. (2010), Paternostro et al. (2007), Pevcin (2004), Shah (2005), Shelton (2007), and Simões (2011).

Overall, these studies provide some evidence that public expenditures on infrastructure and education affect economic growth. Some studies find that certain expenditures typically characterized as directly productive, such as certain types of social benefits and justice. may lead to an economic increase. The literature shows that few studies analyze the composition of public expenditure and use individual time-series analysis (Cullison, 1993; Singh and Weber, 1997).

Our study aims to fill this gap for ten selected CEE countries, using data available from Eurostat, the International Monetary Fund (IMF), and the World Bank for the period 1995-2015, analyzing differences in the composition of public expenditure in these countries.

Our study is unique in that its complex analysis is organized using two major dimensions: first, taking into account the entire COFOG classification we analyze public expenditure according to category and, second, identifying which types of public spending have an economic impact in each of the ten CEE states.

3. METHODOLOGY

The endogenous growth model developed by Devarajan et al. (1996) is used in this study, with GDP growth considered a function of various components of public expenditure and control and dummy variables. We define the following functional relationship:

GDP = f (defense, economic affairs, education, health, general public services, social protection) (1)

The indicator for real GDP, calculated as an index, is used to measure growth: $(GDP_t - GDP_{t-1})/GDP_{t-1} * 100$. To identify the effect of public spending, we use the following components: defense, economic affairs, education, health care, general public services, and social welfare. All the variables in the study are regarded as nominal values in euros and transformed into their natural logarithm.

As for the use of other variables in defining the growth model, the articles mentioned above show that a number of variables are indispensable to the analysis—for example, *population* (which has strong pressure on public spending, especially because of its growth); *EU economic growth* (because of strong economic integration between the countries analyzed and the European Union, as economic growth in the EU directly affects new member states); *school enrollment* (higher enrollment leads to a more educated population and higher levels of professional development, with a positive effect on economic growth); *inflation* (which influences public spending as a reflection of cyclical factors, in the way that, in the context of an anti-cyclical policy, its growth will lead to a decrease in public expenditure and, with pro-cyclical policy, its growth will generate an increase in expenditures); *private investment* (having a different structure of expenditure has different effects on private investment: some may crowd in public investment and lead to economic growth, while others may crowd out and negatively affect economic growth). At the same time, during the period analyzed, the selected CEE countries joined the EU in two phases (2004 and 2007), so this difference was also considered, as it was expected that accession to the EU would lead to convergence in public expenditure with the more developed Western European countries. We introduced a dummy for EU accession, which take the value of 0 before joining the EU and 1 after accession. For the structural breaks, we introduced a dummy that takes the value 0 for the time before the structural break, and 1 for the time of the break.

Thus, incorporating these variables, equation (1) becomes:

GDP = f (defense, economic affairs, education, health, general public services, social welfare, population, EU economic growth, school enrollment, inflation, investment, dummy for EU accession, dummy for structural break) (2)

In log-linear form, the model becomes:

$$ln\ GDP_t = Ln\beta_0 + \beta_1 ln(def_t) + \beta_2 ln(econ_t) + \beta_3 ln(educ_t) + \beta 4 ln(health)_t + \beta 5 ln(gps)_t + \beta_6 ln(socwel)_t + \beta_7 ln(pop)_t + \beta_8 ln(EUecgr)_t + \beta_9 ln(schenr)_t + \beta_{10} ln(infl)_t + \beta_{11} ln(invest)_t + \beta_{12} dummyEU_{accession}\ t + \beta_{13} dummy_{structbreak1\text{-}12\ t} + \varepsilon_t \quad (3)$$

GDP is real gross domestic product, *def* is total expenditure on defense (i.e., financial resources a country spends on forming and maintaining armed forces or other methods essential for defense purposes); *econ* is total expenditure on economic affairs (i.e., financial resources a country spends on the general economy, commerce, and labor; agriculture, forestry; fishing and hunting; fuel and energy; mining, manufacturing, and construction; transportation; communications; other industries, and R&D related to economic affairs); *educ* is total expenditure on education (i.e., direct spending on educational institutions as well as education-related subsidies to households administered by educational institutions); *health* is total expenditure on health care (i.e., financial resources a country spends on medical products, appliances and equipment; outpatient services; hospital services; public health; and R&D related to health care); *gps* is total expenditure on general public services (i.e., financial resources a country spends on executive and legislative organs, financial and fiscal affairs, external affairs; foreign economic aid; general services; basic research; public debt transactions, transfers among different levels of government in general); *socwel* is total expenditure on social welfare (i.e., financial resources a country spends on addressing sickness and disability; old age; veterans; family and children; unemployment; housing; R&D; social welfare and assistance to disadvantaged populations); *pop* is total population, *EUecgr* is EU economic growth, and *schenr* is school enrollment (total enrollment in tertiary education, regardless of age, expressed as a percentage of the population at the age of official tertiary education).

β_1 to β_{13} are the slope coefficients, β_0 is the intercept, u is the stochastic term, or the error term with zero mean and constant variance.

Because the analysis is carried out over the time series, an important issue to consider is the endogenity problem. In our case, however, we have tried to eliminate this problem by using the ARDL model and by calculating the variables, not as in the other studies as a percentage of GDP, but in current prices in euros, seasonally adjusted according to ARIMA2.

To analyze the impact of the structure of public expenditure on economic growth, the ARDL model is used to highlight the relationship among variables. It is a cointegration test, known in the literature as a bound test. We chose this method for three reasons. The first is its calculation technique, which is simpler than that in other multivariate cointegration methods, used for estimating cointegration. The second reason assumes that the time series do not have the same order of cointegration, 0 or 1; rather, they can be different. The third is the fact that the model can estimate the coefficients in the short term and long term simultaneously. Therefore, the ARDL model proposed by Pesaran, Shin, and Smith (2001) is used to show the relationship between the structure of public expenditure and economic growth in the ten selected CEE countries from 1995 to 2015.

The model used in our analysis is derived from the model developed by Colombier (2011).

We use the following model:

$$\Delta rGDP_t = \alpha_1 + \sum_{i=1}^{p} \alpha_2 \Delta rGDP_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta def_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta econ_{t-i} + \sum_{i=1}^{p} \alpha_5 \Delta health_{t-i} + \sum_{i=1}^{p} \alpha_6 \Delta gps_{t-i} + \sum_{i=1}^{p} \alpha_7 \Delta socwel_{t-i} + \sum_{i=1}^{p} \alpha_8 \Delta pop_{t-i} + \sum_{i=1}^{p} \alpha_9 \Delta EUecgr_{t-i} + \sum_{i=1}^{p} \alpha_{10} \Delta edrate_{t-i} + \sum_{i=1}^{p} \alpha_{11} \Delta infl_{t-i} + \sum_{i=1}^{p} \alpha_{12} \Delta invest_{t-i} + \beta_1 rGDP_{t-1} + \beta_2 def_{t-1} + \beta_3 econ_{t-1} + \beta_4 health_{t-1} + \beta_5 gps_{t-1} + \beta_6 socwel_{t-1} + \beta_7 pop_{t-1} + \beta_8 EUecgr_{t-1} + \beta_9 schenr_{t-1} + \beta_{10} infl_{t-1} + \beta_{11} invest_{t-1} + \beta_{12} dummy_{EUaccession\ t-1} + \beta_{13} dummy_{structbreak1\text{-}12\ t-1} + \varepsilon_t \quad (4)$$

where Δ is the first-difference operator, p is the lag order, and all variables are expressed in logarithms.

The expressions with the summation sign (α_1 – α_{12}) represent the short-run dynamics of the model, while the long-run multipliers are given by the coefficients of the lagged-level variables (β_1–β_{13}). Equation (4) can also be interpreted as an ARDL (p, q) model. The residuals ε_t are assumed to be white noise and normally distributed.

According to Pesaran, Shin, and Smith (2001), use of the ARDL model involves two stages: in the first stage, the existence of any long-term relationship among the variables of interest is determined using an *F*-test; in the second stage, the long-term relationship coefficients are estimated, and their values are determined. This is followed by estimating short-term elasticity for variables from the ARDL error correction model.

When some series are stationary at the level I(0), and others are stationary at the first-difference level I(1), the traditional cointegration Johansen test cannot be applied. This problem could be solved by using the ARDL model, developed by Pesaran, Shin, and Smith (2001) through the observation of the long-term relationship among variables. The cointegration method used in this study, ARDL, allows the testing of the long-run relation among variables with a different integration order.

The null and alternative hypotheses (according to which all coefficients equal zero) are as follows:

H_0: $\beta_i = 0$ and $\beta_i = 0 = \beta_2 = K = \beta_{12} = 0$ there is no cointegration among variables (5)

H_1: $\beta_i \neq 0$ and $\beta_i \neq \beta_2 \neq K \neq \beta_{12} \neq 0$ there is cointegration among variables (6)

In order to establish the accuracy of the ARDL model, diagnostic tests are performed (series correlation, normality, and heteroskedasticity associated with the model), as well as stability tests (sum of cumulative residues and cumulative sum of recursive residual squares). For the cointegration relation in Equation 4, we tested the methodology formulated by Perasan for the ARDL model: the null hypothesis of the nonexistence of cointegration will be rejected if the calculated *F*-statistic is higher than the superior threshold critical value; if the calculated *F*-statistic is lower than the inferior threshold critical value, then we cannot reject the existence of cointegration; if the calculated *F*-statistic is during the interval inferior-superior threshold, then the zero hypothesis is confirmed, meaning that there is no cointegration among variables. In this study, the maximum lag length was four, considering the quaterly data.

Because we are analyzing time series, we assume that they have structural breaks, and it is crucial to explain the model correctly. To identify them, we use the Bai-Perron unit-root test for multiple breaks. Therefore, based on the structural break date, in Equation (4) we use the dummy variable $Dummy_{structbreak}$, which represents the structural break in every series and equals 0 until the break and 1 during the time of the break.

In the third stage, the error correction model is estimated, which indicates the speed of adjustment to the long-run equilibrium after a short-run shock. A general error correction representation of Equation 2 is given below:

$$\Delta rGDP_t = \alpha_1 + \sum_{i=1}^{p} \alpha_2 \Delta rGDP_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta def_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta econ_{t-i} + \sum_{i=1}^{p} \alpha_5 \Delta health_{t-i} + \sum_{i=1}^{p} \alpha_6 \Delta gps_{t-i} + \sum_{i=1}^{p} \alpha_7 \Delta socwel_{t-i} + \sum_{i=1}^{p} \alpha_8 \Delta pop_{t-i} + \sum_{i=1}^{p} \alpha_9 \Delta EUecgr_{t-i} + \sum_{i=1}^{p} \alpha_{10} \Delta edrate_{t-i} + \sum_{i=1}^{p} \alpha_{11} \Delta infl_{t-i} + \sum_{i=1}^{p} \alpha_{12} \Delta invest_{t-i} + \delta ECT_{i-1} + \varepsilon_t \quad (7)$$

where δ is the speed-of-adjustment parameter and *ECT* are the residuals obtained from the estimated cointegration model of Equation (4).

In the cases in which the datasets analyzed are integrated (nonstationary), causality tests are based on a multivariate vector autoregressive VAR (Dolado and Lütkepohl 1996; Lütkepohl and Reimers 1992; Saikkonen and Lütkepohl 1996; Toda and Yamamoto 1995). In this analysis, we used the methodology introduced by Toda and Yamamoto (1995), although, given that the variables are cointegrated, the methodology proposed by Lütkepohl and Reimers (1992) to determine the direction of causality between time series might suffice.

4. EMPIRICAL RESULTS

The analysis conducted in the study is characteristic of time series analysis: analysis of stationary series using an augmented Dickey-Fuller ADF test, identifying the structural breaks using the Bai-Perron test, estimation of the ARDL model, estimation of long-run coefficients and Toda and Yamamoto causality testing, to estimate the correlation among variables.

The estimations are performed based on OECD data National Accounts. Volume II: Detailed Tables), because it provides information about detailed public expenditure at all levels of government. Besides this source, additional statistical data from the World Bank, Eurostat (General Government Accounts and Statistics), and the IMF (Government Finance Statistics) are used to obtain several statistical series and fill the gaps in the basic sources. The period analyzed is 1995Q1-2015Q4, the series being expressed in current prices in euros, seasonally adjusted according to ARIMA2. The countries analyzed are ten CEE countries: Bulgaria, Czech Republic, Hungary, Estonia, Latvia, Lithuania, Romania, Poland, Slovakia, and Slovenia. Before applying the methodology presented in the previous section, we note some statistics to allow meaningful comparisons among the countries analyzed. Table 1 shows the basic descriptive statistics for the period of analysis for the selected countries.

Table 1 shows that public spending varies in the countries under analysis from 0.592 to 4.582. The biggest increases in defense spending (*def*) were in Estonia (2.981), Lithuania (2.780), and Latvia (2.493), the smallest increases were in Slovenia (0.592) Bulgaria (0.687), Hungary (0.799); in economic affairs spending (*econ*), the leaders were Estonia (2.550), Bulgaria (2.506), and Slovenia

(2.198), and the least was in Hungary (1.644), Poland (1.027), and Czech Republic (0.247); in the education spending (*educ*), the biggest increases were in Lithuania (2.650), Romania (2.640), and Bulgaria (2.434), the smallest were in Hungary (1.324), Slovenia (0.795), and Poland (0.746); general public services (*gps*) has a maximum of 2.640 in Romania and a minimum of 0.769 in Poland; in health care (*health*), the biggest increases were in Slovakia (4.582), Lithuania (3.083), and Romania (3.021), the smallest were in Hungary (1.281), Slovenia (1.010), and Poland (0.987); in social welfare (*socwel*), the leaders were Estonia (2.872), Lithuania (2.756), and Bulgaria (2.408), and the least was in Hungary (1.052), Slovenia (1.012), and Poland (0.707). Economic growth in these countries ranged between 1.811 and 2.632, the leader being Estonia with 3.34. All the Eastern European countries show growth rates higher than the EU average of 1.491, hence the effect of including these economies. Inflation is positive in all the countries analyzed, with Bulgaria as the leader (6.463) and Slovakia at the bottom of the list (0.069). School enrollment increased in all the countries surveyed, especially in the Czech Republic and Hungary. The population in these countries significantly declined over the period analyzed, except in the Czech Republic, Slovakia, and Slovenia.

Table 1. Descriptive statistics (average)

	Gdp	*Def*	*Econ*	*Educ*	*Gps*	*Health*	*Socwel*	*EUECGR*	*Infl*	*Invest*	*Schenr*	*Pop*
Bulgaria	1.875	0.687	2.506	2.434	1.471	3.016	2.408	1.491	6.463	0.130	0.587	-0.793
Czech Republic	1.811	1.315	0.247	1.723	1.862	2.229	1.988	1.491	0.090	0.028	1.165	0.105
Estonia	2.632	2.981	2.550	2.372	2.291	2.947	2.872	1.491	0.270	0.064	0.134	-0.447
Hungary	1.834	0.799	1.644	1.324	1.093	1.281	1.052	1.491	0.232	0.113	1.005	-0.245
Latvia	2.245	2.493	2.177	2.287	2.401	2.342	2.272	1.491	0.128	0.126	0.201	-1.114
Lithuania	2.606	2.780	2.173	2.650	2.583	3.083	2.756	1.491	0.202	-0.155	0.244	-1.109
Poland	2.544	0.929	1.027	0.746	0.769	0.987	0.707	1.491	0.230	0.139	0.195	-0.027
Romania	2.151	1.758	1.728	2.640	2.640	3.021	2.243	1.491	0.653	-0.121	0.070	-2.133
Slovakia	2.139	1.898	2.108	2.271	2.372	4.582	2.029	1.491	0.069	0.033	0.145	0.061
Slovenia	1.942	0.592	2.198	0.795	0.924	1.010	1.012	1.491	0.113	-0.030	0.186	0.232

Before using the ARDL model, we need to establish the order of integration for time-series analysis, because many economic phenomena have nonstationary elements. Table 2 presents the results of an ADF unit-root test, integration with order calculation, first by intercept analysis, and then by intercept and trend. To calculate the unit-root test, all variables are in natural log. The results of unit-root tests show that none of the series is I(0) with no trend, but some of them are I(0) in the equation when entering trend, whereas others are stationary trend.

For the level values, a constant and a trend variable were included as determinants, while for the first differences only a constant was introduced. The number of lags was chosen based on the Schwarz information criterion (SIC). The results in Table 2 indicate the stationarity of the level values for the majority of the public expense series and that of the first difference for the GDP growth series and for some components of public expenditure.

We begin our estimation by testing the series analyzed, to identify their stationarity. The analysis of time-series stationarity started with the ADF test. After identifying the stationarity of the time series, we begin our estimation by identifying the structural breaks, using the Bai-Perron (1998) test for each of the eleven series, separately for each of the ten countries.

The test results in Table 2 indicate that the time series has a structural break, both in intercept and trend, with a unit-root problem at the level test. As expected and according to economic conditions, the structural breaks appear during 2008-2009; that is, during the financial crisis. These break points are fairly similar in all the time series.

Table 2. Unit-Root Test and Bai-Perron Test Results (probability, t-statistics, order of integration for the series, structural breaks)

	Gdp	*Def*	*Econ*	*Educ*	*Gps*	*Health*	*Socwel*	*Schenr*	*Euecgr*	*Infl*	*Invest*	*Pop*
Bulgaria	0.001	0.016	0.025	0.000	0.013	0.045	0.019	0.045	0.001	0.005	0.001	0.004
	(-5.984)	(-3.354)	(-3.185)	(-5.685)	(-3.435)	(-2.949)	(-3.274)	(-2.944)	(-4.238)	(-4.510)	(-4.889)	(-4.527)
	I(1)	I(0)	I(1)	I(0)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)
	2008Q4		2013Q3				2012Q4		2009q3	2005Q1		
Czech Republic	0.000	0.003	0.002	0.002	0.007	0.000	0.000	0.000	0.001	0.000	0.001	0.000
	(-5.673)	(-5.199)	(-4.669)	(-5.278)	(-5.050)	(-8.781)	(-4.738)	(-5.278)	(-4.238)	(-7.802)	(-4.242)	(-4.617)

	I(0)	I(0)	I(0)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)
	2008Q3	2003Q2	1998Q1		1999Q4				2009q3	1998Q1		
Estonia	0.001	0.040	0.007	0.005	0.003	0.008	0.001	0.008	0.001	0.003	0.009	0.006
	(-4.904)	(-2.990)	(-3.633)	(-5.111)	(-4.629)	(-4.325)	(-4.893)	(-3.598)	(-4.238)	(-5.845)	(-3.529)	(-7.204)
	I(1)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)
	2007Q4		2008Q3						2009q3	1998Q2		
Hungary	0.000	0.000	0.000	0.000	0.003	0.001	0.001	0.011	0.001	0.006	0.001	0.040
	(-6.965)	(-6.454)	(-4.405)	(-5.062)	(-6.642)	(-5.541)	(-7.085)	(-3.453)	(-4.238)	(-3.681)	(-3.241)	(-4.989)
	I(0)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)
	2008Q4		1999Q3				1998Q2	1999Q4	2009q3	1998Q3		
Latvia	0.001	0.008	0.001	0.002	0.002	0.031	0.000	0.002	0.001	0.003	0.002	0.012
	(-14.639)	(-3.594)	(-4.207)	(-4.731)	(-4.057)	(-3.103)	(-6.385)	(-4.731)	(-4.238)	(-5.253)	(-3.942)	(-3.437)
	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)
	2008Q2	2005Q2					2009Q3		2009Q3	1999Q2		
Lithuania	0.006	0.006	0.015	0.000	0.002	0.000	0.000	0.001	0.001	0.008	0.001	0.007
	(-3.647)	(-3.685)	(-3.359)	(-5.095)	(-4.653)	(-4.815)	(-11.257)	(-4.176)	(-4.238)	(-4.316)	(-4.735)	(-5.005)
	I(0)	I(0)	I(0)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)
	2008Q3	2007Q4							2009q3	1998Q1		
Poland	0.000	0.000	0.000	0.000	0.001	0.002	0.001	0.002	0.001	0.002	0.002	0.001
	(-10.017)	(-6.905)	(-5.685)	(-6.117)	(-6.052)	(-5.684)	(-6.574)	(-7.053)	(-4.238)	(-5.828)	(-4.589)	(-6.505)
	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)	I(1)
	2008Q4		2008Q3					1998Q1	2009Q3	2001Q2	2011Q2	
Romania	0.000	0.003	0.005	0.000	0.003	0.024	0.001	0.004	0.001	0.019	0.000	0.000
	(-6.701)	(-3.904)	(-4.451)	(-5.733)	(-5.235)	(-3.196)	(-6.493)	(-4.530)	(-4.238)	(-3.282)	(-19.172)	(-5.056)
	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)
	2008Q4	1998Q4	1999Q4			2008Q1	2003Q3		2009q3	1998Q2	1998Q4	2008Q3
Slovakia	0.004	0.002	0.003	0.002	0.004	0.001	0.001	0.004	0.001	0.001	0.001	0.006

	(-6.504)	(-10.106)	(-6.642)	(-4.427)	(-3.804)	(-4.122)	(-5.451)	(-5.760)	(-4.238)	(-4.213)	(-5.444)	(-7.509)
	I(0)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)
	2009Q1			1998Q1		2013Q1			2009Q3	1998Q3		
Slovenia	0.001	0.003	0.009	0.000	0.012	0.003	0.030	0.002	0.001	0.001	0.023	0.003
	(-4.251)	(-3.765)	(-5.037)	(-6.584)	(-3.459)	(-4.079)	(-5.729)	(-5.831)	(-4.238)	(-5.525)	(-3.211)	(-4.878)
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(0)	I(0)	I(1)
	2008Q4			2010Q3		2010Q1	2011Q1		2009Q3	2001Q3		

Table 3 presents the results of the cointegration test between every COFOG public expenditure series and GDP. The stationarity of the residual values of the cointegration equation, where GDP is the dependent variable and public expenditure is the independent variable, indicates the presence of a cointegration correlation between the two variables, but only in certain countries.

As the ARDL model can also be applied to the time-series combination of I(0) and I(1), we can continue with additional estimates. Optimal lag size is selected using Akaike information criteria, and the dynamic order in regressors is GDP, related expenditure, and other control variables. Considering this order lag, the optimal size is shown in Table 4, choosing the model with the minimum AIC value. After calculating the optimal lag size, we estimate each ARDL model.

Testing for the next phase of the existence of cointegration relationships in the long term involves calculation of the coefficients for dynamic regressors with long-term significance (α and β in Equation 4). The ARDL bounds test results provide evidence of cointegration relationships in both equations at the 1% significance level. Therefore, we tested the ARDL model with Equations (4) and (7).

The next step is to estimate the ARDL model, especially the *F*-statistics, in order to test for the existence of the cointegration correlation among the variables for the period 1995-2015. The *F*-statistics for the ARDL model are reported in Table 4. The critical *F*-statistic values are those computed by Narayan (2005) and Pesaran, Shin, and Smith (2001), and the results for only some models and countries are higher than the superior critical values reported in the studies presented. This confirms the existence of the cointegration correlation among the variables studied for nine of the CEE countries.

We also test the ARDL, setting the initial lag at 1 (optimal lag length base on SIC) and eliminating variables that are not significant, except for the level variables and the intercept. The *F*-statistic of the Wald test on the level variables of the ARDL model (Table 3) confirms the existence of a long-run relationship among the components of government expenditure and economic growth in nine CEE countries, as the test statistics exceed the respective upper critical values for the variables included. Hungary is the only country to which the proposed ARDL model does not apply, with *F*-statistics lower than the bound test values.

The unrestricted ARDL model was used to estimate the model, as reported in Table 3, and the high adjusted R^2 and *p*-values for these five models show that the overall goodness of fit of the models is satisfactory. The *F*-statistics measuring the joint significance of all repressors are statistically significant at 5% for the models for five countries.

Table 3. Results of F Bounds Test for CEE countries

	ARDL	*p*-value	*R*-squared	*F*-statistic
Bulgaria	(1, 0, 2, 0, 0, 3, 0, 3, 3, 1, 0)	0.0164	0.590	8.277
Czech Republic	(1, 1, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1)	0.0052	0.939	8.304
Estonia	(1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1)	0.0013	0.969	7.660
Hungary	(1, 3, 0, 0, 3, 0, 1, 1, 0, 2, 2, 0, 3)	0.4518	0.035	1.107
Latvia	(1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0)	0.0033	0.684	6.570
Lithuania	(1, 0, 1, 0, 1, 0, 2, 0, 1, 2, 1, 0, 1)	0.0016	0.746	7.433
Poland	(1, 0, 0, 1, 3, 0, 2, 1, 1, 0, 0, 2, 0)	0.0021	0.898	9.798
Romania	(1, 2, 3, 0, 2, 0, 0, 2, 0, 2, 0, 0, 3)	0.0223	0.716	6.772
Slovakia	(1, 1, 1, 1, 2, 1, 3, 0, 0, 1, 2, 0, 3)	0.0065	0.756	7.258
Slovenia	(1, 2, 0, 0, 0, 2, 2, 1, 1, 1, 0, 0, 2)	0.0082	0.690	4.925

Critical values I(0) and I(1) come from Narayan (2005, p. 1988); k = 4. *F*-statistic is significant at the I(0) bound-I(1) bound 1% significance level (7.84 - 5.59); 2.5% (6.68 - 6.84); 5% (5.73 - 5.77); 10% (4.78 - 4.94).

The results of the ARDL model show that the *F*-statistics for nine of the ten countries—Bulgaria (8.277), Czech Republic (8.304), Estonia (7.660), Latvia (6.570), Lithuania (7.433), Poland (9.798), Romania (6.772), Slovakia (7.258), and Slovenia (4.925)—are greater than superior critical values in the Pesaran and Narayan article (6.610). In one country, Hungary, the *F*-statistics are between the lower and upper critical values (1.107), so the conclusion is that the variables have no cointegration. The *p*-value and R^2 are also in the line with the previous results: Bulgaria (0.016 and 0.590), Czech Republic (0.005 and 0.939), Estonia (0.001 and 0.969), Hungary (0.451 and 0.035), Latvia (0.003 and 0.684), Lithuania (0.001 and 0.746), Poland (0.002 and 0.898), Romania (0.022 and 0.716), Slovakia (0.006 and 0.756), and Slovenia (0.0082 and 0.690), demonstrating the results again. In addition, in one country (Hungary), the variables analyzed have no cointegration correlation, because the variables are independent.

The selected countries have different cointegration relationships with various components of public expenditure and GDP. In Bulgaria, long-term cointegration relationships exist between GDP and public expenditure on economic affairs (0.001), education (-0.602), general public services (0.252), health care (0.146), and social welfare (0.385); all these relationships have a single cointegration equation. In Czech Republic, one cointegration relationship is found: health care (0.473). In Estonia, cointegration relations emerge between GDP and social welfare (-0.961). In Hungary, no component of public expenditure is cointegrated with GDP. Latvia has two categories of cointegration expenditure with GDP: health care (0.287) and social welfare (-0.255). Lithuania has two categories of cointegration expenditure with the GDP: education (0.701) and health care (0.287). In Poland, no categories of public expenditure have cointegration relations with GDP: the only relations are with the control variable, which all have a single cointegration relation. In Romania, two categories of public expenditure have cointegration relations with GDP: defense (0.134) and economic affairs (0.211). Slovakia has one category of cointegration expenditure with GDP: education (0.432). Slovenia has four categories of cointegration expenditure with the GDP: defense (-0.396), education (0.570), health care (-0.473), and social welfare (0.220).

Table 4. Long-Run Coefficients (Coefficient and Probability)

	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
	-0.016	0.028	-0.033	-0.029	**0.191**	0.103	-0.640	**0.134**	0.195	**-0.396**
DEF	(0.501)	(0.305)	(0.513)	(0.715)	**(0.033)**	(0.104)	(0.545)	**(0.002)**	(0.135)	**(0.000)**
	-0.454	0.031	**0.349**	-0.169	-0.610	-0.525	-0.993	-0.684	-0.140	**0.815**
DUMMY EU accession	**(0.000)**	(0.929)	**(0.003)**	(0.823)	(0.255)	(0.478)	(0.172)	(0.435)	(0.793)	**(0.001)**
	0.001	-0.029	0.257	0.017	0.097	-0.075	-0.943	**0.211**	0.174	-0.902
ECON	**(0.000)**	(0.338)	(0.174)	(0.784)	(0.085)	(0.141)	(0.876)	**(0.010)**	(0.152)	(0.803)
	-0.475	-0.246	**0.837**	-0.005	0.110	**0.159**	**0.255**	-0.194	-1.955	**0.545**
SCHENR	**(0.003)**	(0.407)	**(0.009)**	(0.987)	(0.144)	**(0.022)**	**(0.000)**	(0.884)	(0.429)	**(0.002)**
	0.602	0.184	-0.464	0.230	-0.030	**0.701**	0.134	0.124	**0.432**	**0.570**
EDUC	**(0.002)**	(0.196)	(0.274)	(0.155)	(0.848)	**(0.039)**	(0.592)	(0.145)	**(0.001)**	**(0.001)**
	0.088	**0.185**	**0.594**	0.167	0.189	0.276	**0.077**	**0.675**	0.291	**0.226**
EUECGR	**(0.031)**	**(0.021)**	**(0.000)**	(0.391)	(0.265)	(0.191)	**(0.015)**	**(0.018)**	(0.124)	**(0.014)**
	-0.252	0.038	-0.234	0.266	0.205	0.035	0.473	0.039	-0.166	0.020
GPS	**(0.009)**	(0.227)	(0.066)	(0.143)	(0.165)	(0.073)	(0.283)	(0.709)	(0.183)	(0.696)
	0.146	**0.473**	0.730	-0.052	**0.353**	**0.287**	0.778	0.067	-0.037	**-0.473**
HEALTH	**(0.001)**	**(0.002)**	(0.005)	(0.837)	**(0.003)**	**(0.027)**	(0.837)	(0.492)	(0.188)	**(0.005)**
	-0.264	0.076	-0.032	-0.290	**-0.734**	**-0.086**	**1.733**	-0.101	0.401	**0.815**
INFL	**(0.051)**	(0.561)	(0.828)	(0.462)	**(0.002)**	**(0.007)**	**(0.028)**	(0.075)	(0.117)	**(0.003)**
	0.644	0.002	0.049	-0.295	0.037	-0.025	-0.151	0.046	**0.348**	**0.099**
INVEST	**(0.008)**	(0.970)	(0.258)	(0.055)	(0.438)	(0.791)	(0.837)	(0.251)	**(0.032)**	**(0.012)**
	0.232	0.267	-0.047	-0.677	-0.723	-0.023	0.609	0.210	0.088	**-0.044**
POP	**(0.017)**	(0.582)	(0.895)	(0.838)	(0.455)	(0.330)	(0.743)	(0.238)	(0.942)	**0.001**
	0.385	-0.058	**-0.961**	0.270	**-0.255**	-0.435	0.263	-0.158	0.105	**0.220**
SOCWEL	**(0.031)**	(0.713)	**(0.000)**	(0.317)	**(0.018)**	(0.065)	(0.720)	(0.303)	(0.265)	**(0.000)**

To ascertain the goodness of fit of the ARDL model, diagnostic and stability tests are conducted. Table 5 shows that the model passes the Jarque-Bera normality test, the Breusch-Godfrey serial correlation LM test, the autoregressive conditional heteroskedasticity ARCH-LM test, and the Ramsey RESET stability test. Diagnostic test results, seen in Table 5, show that all assumptions about the specified model are met. None of the null hypotheses of no serial correlation, no misspecification, normal distribution of the residuals, and homoskedasticity can be rejected.

Table 5. Diagnostic Tests Results (*F*-Statistics and Probability)

	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
Normality Jarcque-Bera Statistic	0.450 (1.504)	0.466 (0.534)	0.089 (1.658)	0.001 (0.965)	0.114 (2.331)	0.257 (2.709)	0.130 (1.448)	0.977 (0.046)	0.547 (0.364)	0.665 (0.813)
Serial Correlation Breuch-Godfrey LM test	0.057 (3.025)	0.192 (1.696)	0.375 (0.997)	0.031 (3.679)	0.299 (1.232)	0.449 (0.810)	0.924 (1.966)	0.728 (1.136)	0.878 (0.130)	0.922 (1.199)
Autoregressive Conditional Heteroskedasticity ARCH-LM Test	0.165 (1.454)	0.059 (1.819)	0.104 (2.700)	0.142 (1.427)	0.439 (0.603)	0.662 (2.173)	0.882 (0.322)	0.604 (1.943)	0.526 (0.954)	0.254 (1.257)
Specification Error Ramsey RESET Test	0.486 (1.043)	0.454 (1.472)	0.632 (0.231)	0.576 (0.314)	0.061 (3.639)	0.201 (1.670)	0.406 (1.270)	0.265 (1.915)	0.337 (0.967)	0.067 (3.532)

In what follows, we examine the relationships between this public expenditure and GDP growth, using the ARDL model but only for expenditure categories and countries for which cointegration relationships have been previously discovered (Table 4).

As seen in Table 4, in the long term, in Bulgaria public expenditures related to economic affairs, education, health care, and social welfare have positive effects on GDP (positive coefficients: 0.001, 0.602, 0.385), while those concerning general public services have a negative coefficient (coefficient smaller than 0: -0.252). In the Czech Republic, health-care expenditure has a positive impact (0.473). In Latvia, defense and health-care expenditures have a positive impact (0.191 and 0.353) while social welfare spending has a negative impact on GDP (-0.255). In Lithuania, the two categories that have an impact on GDP—education and health care—have a positive impact (0.701 and 0.287). In Romania, spending on defense and economic affairs has a positive impact upon GDP (0.134 and 0.211). In Slovakia, defense expenditure has a positive impact (0.432). In Slovenia, public expenditures related to education and social welfare have a positive effect on GDP (positive coefficient: 0.570 and 0.220) while spending on defense and health care has a negative impact on GDP (-0.396 and -0.473).

In CEE, public spending on education (Bulgaria, Lithuania, Slovakia, and Slovenia) stimulates economic growth, as indicated by signs of significant positive coefficients, also seen in Colombier (2011), Devarajan et al. (1996), Nijkamp and Poot (2004), and Simões (2011). Investment in health care also contributes to economic growth in some countries (Bulgaria, Czech Republic, Latvia, and Lithuania), but it has a negative impact in Slovenia. In addition, defense spending has mixed results (positive in Latvia and Romania and negative in Slovenia); spending on general economic affairs has positive results (Bulgaria and Romania) while social welfare spending has mixed results (positive in Bulgaria and Slovenia and negative in Estonia and Latvia). Considering the resulting coefficients, the interpretation reveals that an increase in spending on education and economic affairs improves economic growth in CEE, while spending on defense, general public services, and social welfare depends on the coefficient for long-term economic growth.

Table 4 provides evidence of the potential effects of economic growth, depending on the contribution of the type of expenditure. Among the positive effects of growth, the largest and most important effects are associated with education, while spending on economic affairs and health care are estimated to have a significantly smaller impact. Defense, general public services, and social welfare spending are expected to have negative growth effects, but in a way no different from "average" statistics.

These results align with a number of findings in the current literature. For example, our findings regarding the positive impact of education and health-care spending are similar to those of Colombier (2011), Devarajan et al. (1996), Nijkamp and Poot (2004), and Simões (2011). However, positive effects on spending on culture and environmental protection are contrary to the results obtained by Agénor and Neanidis (2011), Bose et al. (2007), and partially Fournier and Johansson (2016). Magazzino (2011), Martins and Vega (2014), and Paternostro et al. (2007) obtained for defense spending by Devarajan et al. (1996), Ghosh and Gregoriou (2008) and for those with social welfare similar negative effects. However, our results are contrary to those obtained by Miyakoshi et al. (2010).

The estimated short-run results revealed much the same results of the long-run results as above (Table 6). Defense expenditure has the same mixed results: significant positive/negative effects on real GDP growth (Bulgaria, Hungary, Latvia, Romania, and Slovenia); so does education (Bulgaria and Latvia), health care (Estonia, Latvia, Lithuania, Poland), and social welfare (Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Romania, and Slovakia).

Spending on economic affairs has a significant short-run impact on economic growth (Bulgaria, Czech Republic, Estonia, Poland, and Slovakia).

Table 6. Estimated Short-Run Coefficients (Coefficient and Probability)

	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
	0.231					0.180	0.198	0.122		0.971
D(GDP(-1))	(0.034)					(0.000)	(0.000)	(0.000)		(0.000)
	0.050									
D(GDP(-2))	(0.427)									
	-0.088	-0.043		0.090	-0.021			-0.116	-0.149	-0.026
D(DEF)	**(0.009)**	(0.081)		(0.348)	(0.817)			(0.066)	(0.237)	(0.818)
	-0.062			**0.215**	**-0.229**			**-0.151**		**-0.209**
D(DEF(-1))	**(0.260)**			**(0.010)**	**(0.022)**			**(0.042)**		**(0.050)**
				-0.274						
D(DEF(-2))				**(0.007)**						
	1.907	2.235	-0.566	-0.187	-4.037	0.058	-0.467	-0.068	0.831	0.740
D(DUMMY)	(0.098)	(0.050)	(0.383)	(0.823)	(0.111)	(0.150)	(0.002)	(0.393)	(0.174)	(0.001)
	5.832								-0.348	
D(DUMMY(-1))	(0.849)								(0.292)	
	0.004	**0.064**	**0.301**	0.018			**0.201**		**0.181**	
D(ECON)	**(0.002)**	**(0.005)**	**(0.000)**	(0.785)			**(0.034)**		**(0.017)**	
	0.294	0.872	1.953	1.017	-0.224	0.611	0.761	0.820	-0.761	
D(SCHENR)	(0.038)	(0.020)	(0.000)	(0.063)	(0.885)	(0.000)	(0.001)	(0.001)	(0.339)	
				1.109	-2.936		-0.807	0.850	-0.522	
D(SCHENR(-1))				(0.024)	(0.061)		(0.068)	(0.035)	(0.063)	
D(SCHENR(-2))				-0.989			-0.401			

				(0.019)			(0.040)			
	-0.418			0.254	0.259				0.025	0.042
D(EDUC)	**(0.009)**			(0.159)	(0.122)				(0.807)	(0.782)
	0.476				**0.308**					0.265
D(EDUC(-1))	(0.182)				**(0.048)**					(0.053)
	4.826	-0.570		-0.613		0.076	0.856	0.244	-0.492	-0.404
D(EU_GROWTH)	(0.002)	(0.001)		(0.203)		(0.898)	(0.001)	(0.123)	(0.228)	(0.051)
		-0.235				-1.047		0.627	-0.475	
D(EU_GROWTH(-1))		(0.281)				(0.119)		(0.124)	(0.186)	
	0.064		**-0.254**	-0.008			0.350	**0.620**		-0.105
D(GPS)	**(0.009)**		**(0.000)**	(0.964)			(0.081)	**(0.002)**		(0.165)
	-0.063							0.230		
D(GPS(-1))	(0.105)							(0.265)		
	-0.302		**0.710**	-0.058	0.170	**0.473**	**-0.554**			-0.027
D(HEALTH)	(0.597)		**(0.000)**	(0.837)	(0.102)	**(0.002)**	**(0.014)**			(0.906)
			-0.064		**-0.298**					
D(HEALTH(-1))			(0.110)		**(0.003)**					
	0.145		-0.262	-0.157	-0.150	-0.201		0.033	0.119	0.199
D(INFLATION)	(0.236)		(0.003)	(0.630)	(0.627)	(0.523)		(0.608)	(0.443)	(0.295)
	0.081			-0.597		0.646		0.074		
D(INFLATION(-1))	(0.185)			(0.053)		(0.061)		(0.089)		
	0.084			-0.020		0.078			0.127	
D(INVESTMENT)	(0.078)			(0.745)		(0.214)			(0.035)	
				0.147					-0.130	
D(INVESTMENT(-1))				(0.022)					(0.034)	
	-0.498	-1.953		-0.747	-3.101		0.058			
D(POPULATION)	(0.296)	(0.045)		(0.838)	(0.398)		(0.173)			
		0.797			7.490		-0.588			
D(POPULATION(-1))		(0.450)			(0.035)		(0.032)			
	-0.042	**0.899**	**-1.177**			**0.406**		0.051	0.159	0.230
D(SOCWEL)	**(0.022)**	**(0.000)**	**(0.000)**			**(0.038)**		(0.832)	(0.188)	(0.468)
				-0.650				-0.154	0.245	-0.354
D(SOCWEL(-1))				**(0.041)**				(0.531)	(0.077)	(0.167)
				1.040				**0.387**	**0.312**	
D(SOCWEL(-2))				**(0.004)**				**(0.019)**	**(0.009)**	

We performed Toda-Yamamoto integration tests for the countries and expenditure categories under analysis, in order to reveal the meaning of the interdependent correlation between GDP growth and each category of public expenditure. As seen in Table 7, in the case of public expenditure and GDP growth, the Toda-Yamamoto causality relationship is bidirectional and seldom unidirectional.

Table 7. Summary of the Toda-Yamamoto Causality Tests (GDP growth/variables)

	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
Defense	0.423 (1.036)	0.557 (0.857)	0.264 (1.293)	0.715 (0.670)	0.032 (2.784) →	0.338 (1.159)	0.999 (0.060)	0.006 (3.052) →	0.753 (0.624)	0.013 (2.795) →
Economic affairs	0.016 (6.545) →	0.816 (0.546)	0.210 (1.411)	0.232 (1.361)	0.327 (1.178)	0.862 (0.484)	0.997 (0.127)	0.024 (2.430) ←	0.745 (0.634)	0.820 (0.539)
Education	0.000 (35.884) ↔	0.524 (0.897)	0.080 (1.877)	0.095 (1.801)	0.661 (0.733)	0.045 (2.941) →	0.923 (0.386)	0.019 (2.528) ↔	0.013 (2.685) →	0.036 (2.248) ↔
General public services	0.008 (5.991) →	0.262 (1.298)	0.694 (0.811)	0.977 (0.256)	0.412 (1.046)	0.206 (1.422)	0.345 (1.149)	0.661 (0.734)	0.839 (0.516)	0.646 (0.751)
Health care	0.026 (6.387) →	0.034 (2.266) →	0.470 (0.966)	0.177 (1.497)	0.043 (2.167) →	0.046 (2.132) →	0.749 (0.629)	0.066 (1.965)	0.894 (0.436)	0.011 (2.771) →
Social welfare	0.009 (7.274) →	0.923 (0.386)	0.000 (6.401) →	0.342 (1.152)	0.022 (2.463) →	0.609 (0.794)	0.922 (0.388)	0.275 (1.272)	0.853 (0.497)	0.009 (2.845) ←
School enrollment	0.008 (8.991) ←	0.189 (1.464)	0.000 (7.255) ↔	0.128 (1.658)	0.803 (0.563)	0.003 (3.318) ↔	0.000 (26.339) ↔	0.229 (1.368)	0.367 (1.113)	0.019 (4.391) ←
EU economic growth	0.004 (4.524) ←	0.003 (3.250) ←	0.000 (8.477) ←	0.056 (4.138)	0.208 (1.416)	0.366 (1.115)	0.030 (2.327) ←	0.008 (2.886) ←	0.169 (1.522)	0.008 (6.464) ←
Inflation	0.699 (0.688)	0.461 (0.978)	0.576 (0.833)	0.079 (1.885)	0.006 (4.116) →	0.041 (2.189) →	0.004 (3.208) →	0.181 (1.487)	0.478 (0.956)	0.042 (5.877) →
Investment	0.002 (3.597) →	0.925 (0.384)	0.901 (0.424)	0.062 (5.715)	0.785 (0.585)	0.257 (1.308)	0.958 (0.312)	0.563 (0.849)	0.033 (2.286) →	0.015 (10.397) ↔
Population	0.675	0.642	0.842	0.102	0.355	0.335	0.966	0.612	0.990	0.099

(0.717)	(0.756)	(0.512)	(1.764)	(1.132)	(1.164)	(0.290)	(0.790)	(0.195)	(0.416)

*** → unidirectional influence from GDP to variable; ← unidirectional influence from variable to GDP; ↔ bidirectional influence between GDP and variable

In Bulgaria, the Granger causality among expenditures related to education is bidirectional: GDP influences these types of expenditure, and in exchange these types of expenses also influence GDP. In economic affairs, general public services, health care, and social welfare, the relationship is unidirectional: GDP influences these types of expenses. In the Czech Republic, the Granger correlation between expenditure and GDP is unidirectional: GDP influences health care. In Estonia, the Granger correlation between social welfare spending and GDP is unidirectional: GDP influences expenditures. In Latvia, the Granger correlation between expenditure and GDP is unidirectional: defense, health care, and social welfare are influenced by GDP. In Lithuania, the Granger correlation between expenditure and GDP is unidirectional: from GDP to education and health care. In Romania, the correlation between education and GDP is bidirectional since they influence each other; in exchange, economic affairs expenditures show unidirectional causality with GDP, and GDP influences defense spending. In Slovakia, the Granger correlation between expenditures and GDP is unidirectional: GDP influences education. In Slovenia, the correlation between education and GDP is bidirectional, because they influence each other; in exchange, social welfare expenditure shows unidirectional causality with GDP, and GDP influences defense and health-care spending.

The results are similar to those ones obtained by Barro amd Sala-i-Martin (1992), Colombier (2011), Devarajan et al. (1996), and Nijkamp and Poot (2004), and contrary to those of Agénor and Neanidis (2011), and similar in part to those of Fournier and Johansson (2016).

5. CONCLUSION

In our study, we analyze the correlation between real GDP growth and ten different types of public expenditure (according to the functional COFOG classification), using quarterly data for the period 1995-2015, for ten selected CEE countries that became EU members. Our study methodology employs time-series analysis: testing the data series for stationarity, cointegration, ARDL modeling, and Toda-Yamamoto causality. Using a time-series methodology allowed us to obtain clearer answers regarding the uniformity of results, short-run and long-term responses, and the impact of each category of expenditure on economic growth.

Two of the ten countries analyzed (Hungary and Poland) have no cointegration relationship between the two variables structured according to the COFOG classification, namely, in public expenditure and GDP, because these variables are interdependent. The other eight countries (Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Romania, Slovakia, and Slovenia) show different cointegration correlations among certain components of public expenditure and GDP. Bulgaria has the highest number of cointegration relationships between public expenditure and GDP, five; Slovenia has four, Romania and Latvia three; Lithuania has only two; and the Czech Republic and Slovakia each have one cointegration relationship.

Concerning the influence of expenditure types on GDP, these satisfy the previous empirical analyses. Thus, spending on defense (Latvia, Romania and Slovenia), economic affairs (Bulgaria and Romania), general public services (Bulgaria), and social welfare (Bulgaria, Estonia, Latvia and Slovenia) have a negative impact on GDP; by contrast, spending on education (Bulgaria, Lithuania, Romania, Slovakia, Slovenia) and health care (Bulgaria, Czech Republic, Latvia, Lithuania and Slovenia) has a positive impact.

This analysis leads to several conclusions. First, various types of government spending have different impacts on economic growth—especially on education (Bulgaria, Lithuania, Romania, Slovakia, and Slovenia) and health care (Bulgaria, Czech Republic, Latvia, Lithuania, and Slovenia)—which means that we can obtain better results through reallocation of spending across sectors, which should improve the effectiveness of public expenditure. Second, governments should try to reduce their spending in unproductive sectors, such as defense (Latvia, Romania, and Slovenia), economic affairs (Bulgaria and Romania), general public services (Bulgaria), and social welfare (Bulgaria, Estonia, Latvia, and Slovenia). Third, in all regions, CEE countries should increase spending on education and health care, as these types of expenditures have a big impact on poverty reduction and improving living conditions.

The results of this study imply that the governments of CEE countries must be careful about the targets of their public spending and about how the funding is used, because it can have positive impacts on economic growth, given that composition matters most.

Another conclusion that can be drawn from these results is that the CEE countries need to facilitate private investment, and they have to put more emphasis on productive components of government spending, by increasing spending on education and health care and by increasing the efficiency of expenditures. Moreover, governments should carefully assess their potential for starting new investment projects in areas such as defense, economic affairs, and general public services.

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