Testing the Relationship between Public Expenditure and Economic Growth in Romania

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Abstract: In this paper we analyze whether the Romanian economic context confirms the Armey model, and present the relationship between public spending and economic growth that may offer a suitable basis for decision makers. The analysis is based on both annual and quarterly data regarding public spending and economic growth in Romania. After investigating the correlation validity, the analytic results did not confirm the premises related to the Armey Curve for the Romanian context during 1990-2011. However the time interval is marked by unpredictable phenomena such as the transition from the state economy to the market economy and the world financial crisis, both is altering the results. The fact determines us to search the coordinates for developing a new model that describes better the connections and the period characteristics.

Keywords: Armey Curve; public spending; fiscal policy; economic growth; Romania

JEL Classification: E62; H50; O40

1 Introduction

Many studies on the determinants of economic growth, present results that demonstrate that a high level of public expenditure affects economic growth. Between the level of public expenditure and the economic growth develops a relation of nonlinear regression (explained by Armey Curve, defined below). This relationship is possible due to the fact that a high level of public expenditure over the optimal threshold, (the economic literature distinguishes several levels, as being

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optimal, according to the countries that has been analyzed), depends on the assessment interval (result even different levels for the same country, for analysis that took into account different periods of time), or on what indicators were calculated to determine the optimum point.

For example, Barro has identified an optimal level for the public sector, namely when the product of the marginal is 1 (the so-called rule of Barro) and, based on the empirical data is a U-shaped curve: this shows the relationship between the rate of growth and the level of public expenditure as a percentage of GDP.

The aim of our paper is to assess if the Romanian economic conditions during the transition period and then the crisis years can be described using the Armey model conditionality (relation of nonlinear regression between the public expenditure and the economic growth). Moreover if the model does not fully explain the evaluated variables evolution we design a model that explains better the period figures and fully reveals the specific connection, the evolution and the characteristics of the assessed variables.

Our work, building on previous empirical studies published by other authors (Arpaia & Turrini, 2008, Bagdigen &Cetintas, 2003, Dalamagas, 2000, Facchini, Melki, 2013) has a new scientific path, analyzing Armey model, Armey D (1995) compatibility or incompatibility with the Romanian economy. The Romanian economy followed the transition from a centralist economy to a free market economy, and, after that, endeavored to adapt to common (EU) market competitive conditions. The specific conditions of the economic crisis are also important, because they can influence the results of the study. These transforming steps imposed structural and value changes in terms of fiscal-budgetary indicators taken into account in this study. These changes can, however, result in interpretations counter to, and uncertainty with, our analysis and the results obtained. Another new element besides the economic assessment and data-series analysis, is the Romanian economy dual evaluation (quarterly and annual), that includes the use of econometric techniques that accommodate the objectives of our research.

The paper is structured as follows. Section 2 presents the literature review that presents the main concepts relevant to the Armey model simulation, and argues important matters related to all possible influences of the public expenditure on economic growth. Section 3 presents the methodology, the data, the model to be tested and the results of empirical analysis that was carried out quarterly.

Section 4 presents the methodology, the data, the model to be tested and the results of the empirical analysis that was carried out yearly. Section 5 concludes.

2. General Organization of the Paper

The idea about the validity of a linear relationship between public expenditure and economic growth was reshaped and popularized in several studies MCDonald BD, Miller, 2010, Roy, 2009, Sheehey, 1993, Tridimas, Winer, 2005, Yuk, 2005, Sineviciene, Vasiliauskaite, 2012; Bobinaite, Juozapavicien & Konstantinaviciute, 2011). For example, Heitger, 2001 assessed and demonstrated that if the level of public expenditure increases due to consumer spending, the effect on GDP is negative while an increase in government spending based on the public investment growth has positive effects on economic growth. He shows that at the level 0 for the public sector, the level of GDP is very low, because public goods are not satisfactorily provided.

As the public sector level increases (spending and/or taxes as the GDP share) and public services are provided, the economic activity of the country is also growing. A new increase in the public sector would mean that the government is providing both public goods and private goods, and, if this trend continues, there will be a reduction in the level of GDP while the public sector will increase because of the lessening motivation to work, invest and innovate in the context of increasing taxation.

The notion of an "optimal level of public expenditure" has been popularized by Armey, who designed the curve named after him Armey D (1995). The author argued that the absence of government, causing a state of anarchy and low levels of GDP per capita, since there is no rule and the right of property is not protected. Accordingly, there is no incentive to save and invest, because of the risk of expropriation. Similarly, when all decisions are made by the government, the GDP per capita is also reduced. When there is a mix between public and private decisions on capital allocation, GDP should be higher. Thus, the expansion of public expenditure (from low levels) should also be associated with the output expansion. However, as the public expenditure increases, additional projects funded by the government become increasingly less productive and the taxes and loans for financing the government activities are becoming increasingly larger. At a certain point, the marginal benefit of increased public spending drops to zero.

Generally, according to other studies (Chen, 2006, Lee, Lavoie, 2013), there are two groups of economists who have shown the two types of relationships between public expenditure and economic growth. The first group has found a negative relationship (Engen, Skinner, 1992; Hansson, Henrekson, 1994; Romero, Strauch, 2003; Slemrod, 1995; Schaltegger, Benno, 2006) between the level of public expenditure and economic growth. These authors believe that increasing the level of public expenditure will lead to the decline of economic growth and the crowding-out effect on private investments, in the context that, when the government increases its spending it needs extra taxation to pay for additional growth of public expenditure, a condition that has negative effects upon the economy. The second group of

economists has established a positive relationship (Tanzi, Schuknecht, 2000, Chen, Lee, 2005) between the size of public expenditure and economic growth, claiming that the increase of public expenditure will encourage private investment by improving the investment climate (Magazzino, 2012; Mavrov 2007).

Armey has implemented the Laffer Curve to show the relationship between the size of the public sector and economic growth, after which (Vedder & Gallaway, 1998) have shown in 1998 on the basis of empirical analysis that the public sector and economic growth are asymmetrical. They showed that this asymmetrical relationship is an Armey Curve, indicating that a reduced public sector aims to protect private property and to provide public goods. When the public sector increases, the result is excessive public investment that will create an effect of crowding out private investment, and will increase taxes and interest payments, all of which will affect the economy.

A low level of public sector will have an effect of promoting economic growth. The authors Vedder and Gallaway have plotted the relationship between the public sector and growth in the form of an inverted U curve.

Due to the shape of the inverted U, the optimal level of the public sector can be found, that will ensure the highest rates of economic growth. The above mentioned authors have found this maximum point Vedder, Gallaway, 1998 to be at a 17.45% level for the U.S. economy for 1947-1997. In addition, the optimal level of the public sector, calculated as the ratio of total public expenditure and economic growth, was calculated for Canada, between the years 1854-1988 (21.37%), Denmark between the years 1854-1988 (26.14%), Italy between the years 1862-1988 (22.23%) and the United Kingdom between the years 1830-1988 (20.97%).

Another analysis (Pevcin, 2005), developed to test the existence of the Armey Curve in 12 of the 27 countries of the European Union for the period 1950-1996, has shown that an individual Armey Curve can be designed for countries such as Italy, France, Finland, Sweden, Germany, Ireland, the Netherlands and Belgium, while for countries such as the United Kingdom, Austria, Denmark, and Norway, the curve could not be obtained, the coefficients of the regression curve not being significant in statistical terms. For countries for which the curve was designed, the optimum level of public expenditure as percentage of GDP, can be viewed in works like Pevcin, 2005.

Other studies (Davies, 2009) have analyzed the Armey Curve by expanding the economic-growth representation to the human-development index (HDI), thus endeavoring to highlight the relationship in the reverse U-shape between the level of public expenditure as percentage of GDP and the human-development index. This is so because, while the GDP measure productivity in aggregate form, HDI ("the generally accepted index, measuring the comparative international welfare") Wallace 2004), reflects the types of goods and services composing the GDP.

3. Specification of the Variables and Econometric Results for Quarterly Analysis

3.1. Data, Sources and Model Validation

Methodology: In general, most of the economists can accept the validity of the inverse U curve as a realistic description of the relationship between the evolution of public expenditure and economic growth. In essence, an empirical analysis is needed to validate this curve.

To test the validity of the Armey Curve (the relationship between the level of government spending and economic growth, designed as an inverse U curve) on the Romanian economy we initially used quarterly data from the 2000 1st quarter-through 2011 1st quarter(Chirila& Chirila, 2011). The analysis was carried out in the econometric program EWiews. The first stage of the review was to determine the actual values of the variables analyzed (the first variable: the rate of GDP growth, calculating quarterly growth values as differences compared with the same quarter of the previous year; the second variable: the total public expenditure as a percentage of GDP, calculated quarterly values again by comparison with the same quarter of the previous year) by taking the HCPI (available in Eurostat's database with fixed base in 2006) as a comparison base for transforming the nominal value into real value. Since quarterly data are affected by seasonality, they were subject to seasonal adjustment procedures. For the seasonally-adjusted time series, we have used the ARIMA (Autoregressive Integrated Moving Average) x 12 method (see Figure 1 and Figure 2).
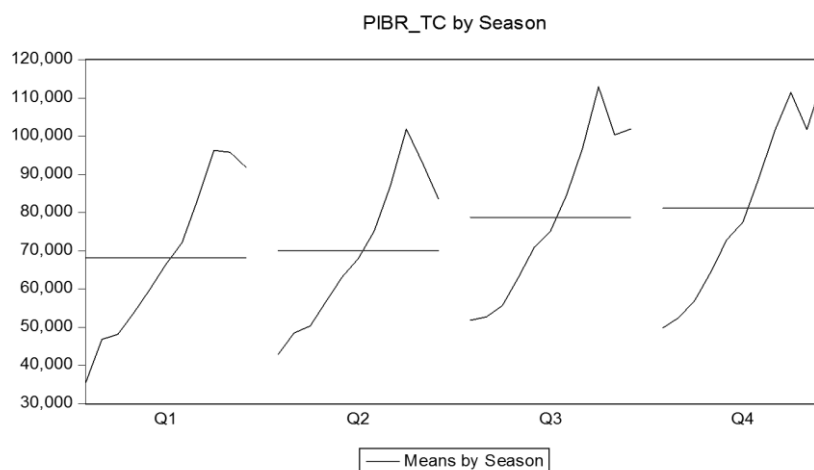
Figure 1. Economic growth evolution (seasonally)

Note: PIBR = Gross domestic product in real terms
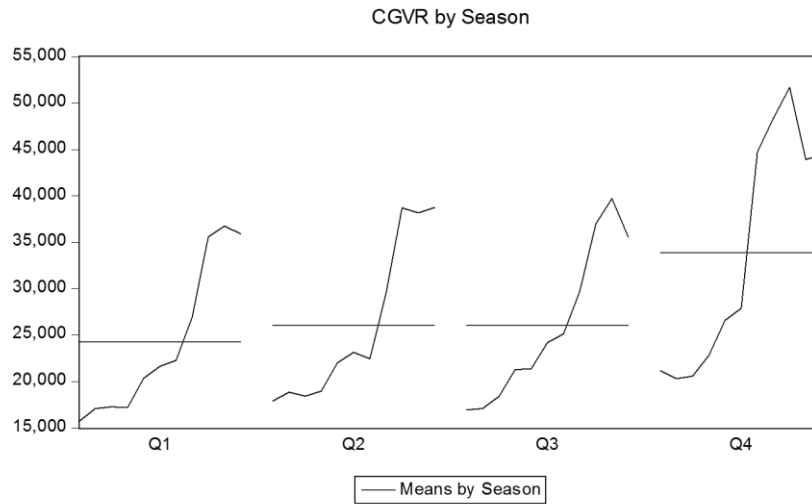
Figure 2. Public spending evolution (seasonally)

Note: CGVR = Public spending in real terms

Since neither of the two time series was stationary (procedure verified by the Augmented Dickey-Fuller test), we proceeded to make them stationary. Thus, the seasonally adjusted time series were transformed by calculating the first difference (see Table 1 and Table 2).

Table 1. Stationary testing of the public spending, in real terms, seasonally adjusted

Null Hypothesis: DCHPR_SA has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=9)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-7.463847	0.0000
Test critical values: 1% level	-3.615588	
5% level	-2.941145	
10% level	-2.609066	
Note: *MacKinnon (1996) one-sided p-values, DCHPR_SA = Public spending in real terms, seasonally adjusted		

Table 2. Stationary testing of the GDP, in real terms, seasonally adjusted

Null Hypothesis: DPIBR_SA has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.024291	0.0002
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

Note: *MacKinnon (1996) one-sided p-values, DPIBR_SA = Gross
domestic product in real terms, seasonally adjusted

The evolution graph of the two seasonally adjusted and stationary variables quarterly is shown in the Figure 3:
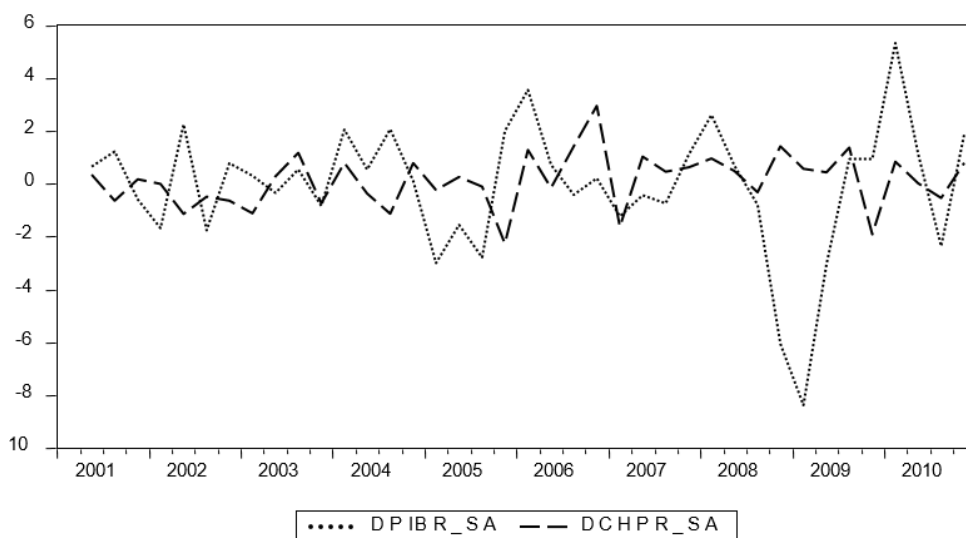
Figure 3. The evolution of economic growth and public spending in Romania, 2001-2010 (quarterly values)

Notes: DCHPR_SA = Public spending in real terms, seasonally adjusted, DPIBR_SA = Gross domestic product in real terms, seasonally adjusted

4.2. Econometric Results

Estimation of the hyperbolic regression model: The next stages of the analysis are the estimation of the hyperbolic regression model and model testing. Table 3 in the Annex present the estimation of the regression model for quarterly analysis.

Table 3. Estimation of the regression model for quarterly analysis

Dependent Variable: DPIB
Method: Least Squares
Sample (adjusted): 2000Q2 2009Q4
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.500924	0.632001	-0.792600	0.4332
DChP	-0.095390	0.071722	-1.329997	0.1919
DChP^2	0.008123	0.010801	0.752118	0.4569
R-squared	0.046835	Mean dependent var		-0.121538
Adjusted R-squared	-0.006119	S.D. dependent var		2.469228
S.E. of regression	2.476771	Akaike info criterion		4.725592
Sum squared resid	220.8382	Schwarz criterion		4.853558
Log likelihood	-89.14904	Hannan-Quinn criter.		4.771505
F-statistic	0.884446	Durbin-Watson stat		1.210796
Prob(F-statistic)	0.421724			

Notes: DChP = Public spending in real terms, DPIB = Gross domestic product in real terms

The regression-model parameters are not significantly different from zero and the errors do not comply with the lack of autocorrelation hypothesis. The important conclusion is that we cannot write a relation described as an inverse U (Armey Curve) between economic growth and the share of public expenditure in GDP on the quarterly data. Therefore we try to create the residual variable of this model estimated earlier by the Box & Jenkins methodology to achieve a regression model that satisfies all the assumptions.

Table 4. Re-estimation of the regression model for quarterly analysis

Dependent Variable: DPIB				
Method: Least Squares				
Sample (adjusted): 2001Q2 2009Q4				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DChP	-0.080767	0.034964	-2.309973	0.0273
AR(4)	-0.644531	0.154090	-4.182829	0.0002

Notes: DChP = Public spending in real terms, DPIB = Gross domestic product in real terms

The general pattern is of the form:

$$Y = \alpha + \beta X + \varepsilon \tag{1}$$

where: Y is the dependent variable; α = term; β = the independent variable; X = the independent variable; and ε=residual variable.

The model that results is of the form:

$$GDP = -0.080767 * ChP + \varepsilon t - 0.0644531 * \varepsilon t\text{-}1 \tag{2}$$

where: GDP = real growth, in first difference and seasonal adjusted, DChP = actual total public expenditure level, after seasonal adjusted and calculation of first difference.

In conclusion, the regression model complies with the specific assumptions of a general regression model. Thus the link between economic growth and increased government expenditures (quarterly data) is linear and indirect. According to econometric interpretations that can be made for this case, when the government spending is increased, growth decreases. According to the above model (2), on average, real economic growth drops by 0.080767%, when there is an increase of one unit of the actual total public expenditure level. So, according to Romania quarterly data, we discover that increasing the level of public spending determine a diminished economic growth rate. The phenomena occurs because when the government increases its spending it needs extra taxation to pay for additional growth of public expenditures, a condition that has negative effects upon the Romanian economy as a whole.

5. Specification of the Variables and Econometric Results for Yearly Analysis

5.1. Data, Sources and Model Validation

For testing the existence of the Armey Curve for the specifics of the Romanian economy, we proceeded to analyze the data regarding the evolution of annual economic growth and the level of public expenditure, calculated as percentage of GDP in the period 1990-2010. The data were taken from the Romanian National Institute of Statistics (Statistical Yearbook) and from the Eurostat website (online database) and were calculated and processed with EWiews7.
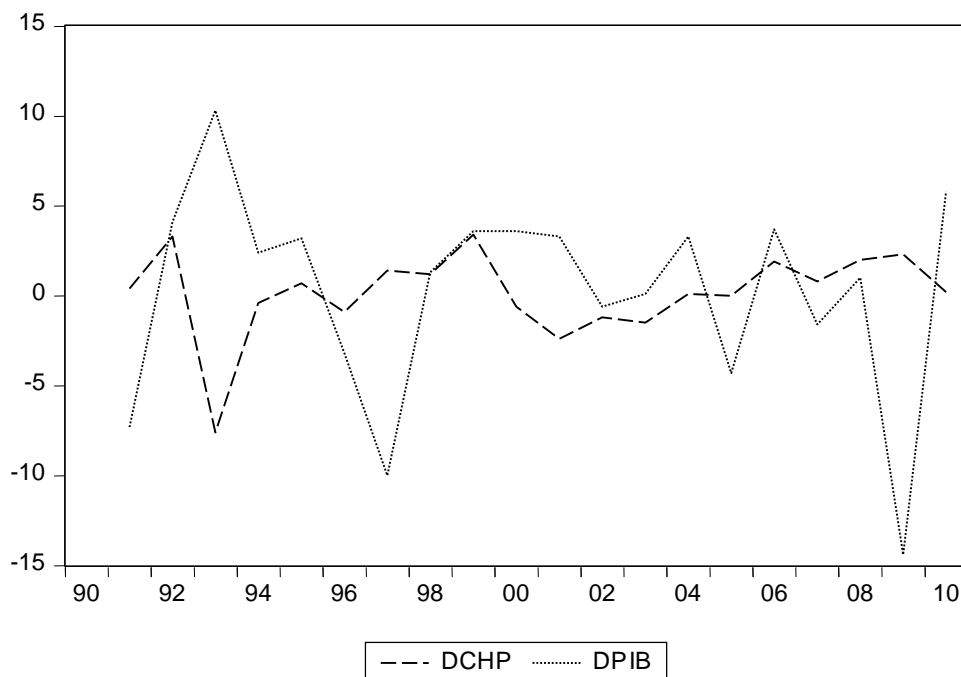
Figure 4. The evolution of the economic growth and public spending in Romania, 1990-2010 (stationary times series)

Notes: DChP = Public spending in real terms, DPIB = Gross domestic product in real terms

According to the Figure 4 (Annex) the evolution of the growth rate of GDP indeed indicates sustainable growth only after 1999, up to and including 2008, with two points up, one in 2004, by 8.5%, and the second by 7.9% in 2006, a period during which the overall level of public spending as a percentage of GDP fell from 39.2% in 1999, to 33.6% in 2005, followed by an increase in public spending of up to 38.3% in the pre-crisis, 2008. The international financial and economic crisis affected Romania (2009-2010) and brought an economic downturn of about 7% that had to be corrected by increasing public expenditures that exceeded 40% of GDP. The initial period analyzed allows interpretations of growth between 1993 and 1996, and here the maximum growth was 7.1% in 1995. If we analyze the relationship between the two variables in the medium term for the two growth periods, we can conclude as follows:

- Average growth in the 1993-1996 period was 4.1%, that corresponds to an average level of total public spending of 33.63% of GDP;
- Average growth in 2000-2008 was 5.84%, that corresponds to an average level of total public spending of 35.62% of GDP;

- The average result of the public expenditure and economic growth assessment, evidenced by the average difference in growth and average difference of public spending can be characterized as follows: an additional 1.99% of public expenditure according to an extra 1.74% growth. Thus, co-evolution of these two indicators reveals that this growth is likely caused, to some extent, by the increase in public expenditure as a percentage of GDP, but it requires calculation including a budget multiplier for the periods analyzed in order to determine whether public expenditure affects economic growth.

Continuing the analysis from the same perspective, we can say the following:

- An average of 39.07% of total public expenditure in GDP corresponds to an average economic decline of -9.1% in the period 1990-1992;
- An average of 36.53% of total public expenditure in GDP corresponds to an average economic decline of -4.03% in 1997-1999;
- An average of 40.7% of total public expenditure in GDP corresponds to an average economic decline of -4.2% in 2009-2010.

Selected annual data series are first tested in terms of stationarity and the results are as expected (seldom macroeconomic variable is stationary), so to work with these stationary series we proceed to transform them by calculating first difference. Since the variables are stationary, we can use them in regression. The regression model was estimated with Scatter plot.

5.2. Data, Sources and Model Validation

Estimation of the regression model was based on three polynomial forms.

The first model has the following general form (Armey model):

$$Y = \alpha - \beta X + \gamma X2 + \varepsilon \ (3),$$

where Y = the previous year's economic growth, expressed by the variance of gross domestic product, is considered by 100; X = rate of public expenditure, expressed as a percentage of GDP; α = free term (constant); β, γ = independent variable parameters; and ε = residual.

Table 2. Estimation of the regression model 1 (yearly analysis)

Dependent Variable: DPIB				
Method: Least Squares				
Sample (adjusted): 1991 2010				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.500363	1.430954	-0.349671	0.0509
DCCGV	-0.833841	0.676337	-0.614178	0.0432
DCCGV^2	0.014356	0.126262	1.137002	0.0415

Notes: DCCGV = rate of public expenditure, expressed as a percentage of GDP, DPIB = Gross domestic product in real terms

Following the procedure of estimation the model by the method of least squares generated the following result:

GDP =-0.50 – 0.83 ChP+ 0.014ChP^2+ε   (4)

Model hypothesis testing (checking errors, autocorrelation and heteroscedasticity) led to the conclusion that the hypothesis is supported. Even if all 3 probabilities calculated are greater than 0.05, we must specify that the model is less statistically significant, given that we need to consider risk acceptance of more than 10%. From Table 4 (Annex), the results show, with regard to economic growth, the influence of variable B (public expenditures) upon the changes in variable A (growth) is 30.14%.

The second model has the following general form:

Y = -β X + γX^2 + ε   (5)

where Y = economic growth, expressed by the variance of gross domestic product; the previous year is considered by 100; X = rate of public expenditure, expressed as a percentage of GDP; and β, γ = independent variable parameters; and ε = residual. Table 4 present the Estimation of the regression model 2 (yearly analysis)

Table 4. Estimation of the regression model 2

Dependent Variable: DCPIB
Method: Least Squares
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DCCGV	-0.504732	0.610761	-0.826398	0.0594
DCCGV^2	0.120346	0.104748	1.148909	0.0556

R-squared	0.195714	Mean dependent var	0.215000
Adjusted R-squared	0.151031	S.D. dependent var	5.749167
S.E. of regression	5.297253	Akaike info criterion	6.266893
Sum squared resid	505.0961	Schwarz criterion	6.366467
Log likelihood	-60.66893	Hannan-Quinn criter.	6.286331
Durbin-Watson stat	2.400052		

Notes: DCCGV = rate of public expenditure, expressed as a percentage of GDP, DPIB = Gross domestic product in real terms

Following the procedure for estimation the model, based on the method of least squares, generated the following result:

GDP = -0.51 ChP + 0.12 ChP2 + ε (6).

Model hypothesis testing (checking errors, autocorrelation and heteroscedasticity) led to the conclusion that the hypothesis is supported, but, because both probabilities calculated are greater than 0.05, we must specify that the model is less statistically significant, given that we need to consider risk acceptance of more than 10%. Table 4 (Annex) also shows that, with regard to economic growth, the influence of variable B (public expenditures) upon the changes in variable A (growth) is 15.10%.

The third model has the following general form:

$Y = \gamma X^2 + \varepsilon$ (7),

where Y = economic growth, expressed by the variance of gross domestic product, the previous year is considered by 100; X = rate of public expenditure, expressed as a percentage of GDP; γ = independent variable parameter; and ε = residual. Table 5 present the Estimation of the regression model 3 (yearly analysis)

Table 5. Estimation of the regression model 3

Dependent Variable: DCPIB

Method: Least Squares

Sample (adjusted): 1991 2010

Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DCCGV^2	0.168349	0.086436	1.947669	0.0564

R-squared	0.165199	Mean dependent var	0.215000
Adjusted R-squared	0.165199	S.D. dependent var	5.749167

S.E. of regression	5.252868	Akaike info criterion	6.204132
Sum squared resid	524.2598	Schwarz criterion	6.253919
Log likelihood	-61.04132	Hannan-Quinn criter.	6.213851
Durbin-Watson stat	2.242118		

Notes: DCCGV = rate of public expenditure, expressed as a percentage of GDP, DPIB = Gross domestic product in real terms

Following the procedure for estimation, the model based on the method of least squares, generated the following result:

GDP = 0.17 ChP2 + ε (8).

Model hypothesis testing (checking errors, autocorrelation and heteroscedasticity) led to the conclusion that the hypothesis is supported, as t-Stat test probability calculated is around 0.05, and we must specify that the model is significant, given that we consider risk acceptance of 10%. From Table 5, the results show the fact that, with regard to economic growth change, the influence of variable B (public expenditures) upon the changes in variable A (growth) is 16.52%.

In conclusion, after testing those three models, we can mention that this Armey Curve cannot be verified for specific economic conditions in Romania, given the specific transformation and its development. Thus, we can accept, but with great reserve, that the first model is relevant with an acceptance risk of 10%. The other two models are correct mathematically speaking, but have flaws for economic interpretation. For us, this perspective is the most important, and while arousing interpretation or rethinking, it best explains the integrated development of the two variables analyzed.

6. Concluding Remarks

As specified above, the link between economic growth and the level of public expenditure as a percentage of GDP can be positive (if we are talking in particular about public investments) or negative (if we consider especially consumption public expenditure – but not all of them). The financing option for this kind of expenditure calls for another assessment. In this case, we need to respect the main rule applied at the enterprise level of covering the long-run needs of funding from long-run available resources, and short-run expenditures covered based on short-run revenues. We note that an increase in taxes reduces the rate of economic growth that, in turn, inhibits the desire for establishing and conducting business.

Regarding the Armey Curve assessment result for the Romanian economy, we must also clarify the relevance of this beyond the theory and the statistical explanations. The study results did not permit us to plot the Armey Curve and explain the connection between the economic growth and the public spending for the Romanian economy during the chosen time interval. This fact is due to some factors such as the macroeconomic mutations (the transition from centralist to market economy) and world financial crisis, elements that alter the assessment, or is due to the exclusion of other important variables.

In particular assessing the two macroeconomic variables connection revealed a linear regression model that describes the dependence the GDP and the public spending (after a complex data analysis). Thus according to the quarterly model (2), on average, real economic growth drops by 0.080767%, when there is an increase of one unit of the actual total public expenditure level. The result is valid using the quarterly adjusted data and can be accepted as relevant if we admit that the Romanian public sector is over sized and its growth rate is too fast related to the GDP growth rate.

It also must be stated that the Romanian economic profile during the evaluated period fall in with massive structural transformation, fact that influence the assessment negative results.

Final remark: the paper is a development of the "research-in-progress" presented at EIRP 2014

7. Acknowledgement

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