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Abstract

This paper tries to verify the existence of the Armey curve, which states that there is an inverted U-shaped relationship between the government size and the economic growth. To that end, we use annual data over 1961-2008 to examine the existence of Armey curve in Greece. Instead of relying on a binomial model, which is very popular in the literature, we use a smooth transition regression (STR). STR models are very flexible and binomial models are considered as a special case of the STR models.

The results show that there is a nonlinear connection, i.e., a threshold effect, between the government spending and the growth rate in the Greek economy. However, since the relationship is positive in both regimes, i.e., before and after the threshold, we cannot confirm the existence of Armey curve in the Greek economy.

Keywords: Government size; Economic growth; Smooth transition regression, Armey curve, Greece

JEL Classification: C22, H50, O40

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1 Introduction

Economic growth is considered one of the most important goals of any country and government plays a crucial role in this regard. The role of government in the economy has been debated for many years; however, there is no consensus about it. For example, Engen and Skinner (1992), Hansson and Henrekson (1994), Fölster and Henrekson (2001), among many, have shown that the government has a negative effect on economic growth. While, Ram (1986), Kormendi and Meguire (1986), and Ghali (1998) have claimed the opposite, i.e., a positive connection between these variables. Therefore, it is of great importance from policy makers' perspective to know whether expanding or contracting the government size would promote the economic growth.

It is well known that a state of anarchy or no-government would result in a very low productivity of the economy. Therefore, to prevent it, economists believe that the government has to establish property rights, remove the allocational distortions due to externalities, provide accessible schooling, establish law and order, enhance the investment environment through providing public goods, and so on. However, if the government grows too big then it could harm economic growth and became an obstacle to that, due to bureaucracy, distortion to efficiency, crowding-out effect, X-inefficiency, and the like. In addition, when the government is large and most parts of the economy is controlled by the government there would be a little space for private companies and the productivity would decline.[1] Consequently, it is necessary to determine an optimal size for the government.[2] However, it is necessary to remember that due to differences in the expenditure compositions, the optimal size of government varies from one country to another. For example, a significant share of public expenditure in the developing countries is allocated to the schooling and construction of infrastructures which play a very important role in stimulating the economy. On the contrary, in the developed countries a large portion of the public expenditure is devoted for providing the social services to the citizens (Forte and Magazzino, 2010).

The neoclassical growth theory and new growth theory, so called endogenous growth model, have different points of view regarding the role of government in the economic growth. The former states that the growth depends on the technological changes and these changes are exogenous. Therefore, government policies could not influence the economic growth in the long run and the government intervention in the economy would cause temporary effects only. On the contrary, the endogenous growth theory suggests that the technological changes are endogenous and the government can create the technological changes by affecting the economic incentives. In other words, as Dar and Amirkhalkhali (2002) stated the government can affect the technological progress, rate of production factor accumulation and their efficiencies through fiscal instruments such as taxation, expenditure, and budget balance (Pevcin, 2004). Thus, the endogenous growth theory admits a relationship between the GDP growth and the government size and states that this relationship could be nonlinear.

Armey (1995) suggested that the relationship between GDP growth and government size is an inverted U-shaped curve, similar to the Kuznets and Laffer curves. This curve is depicted in Figure 1 and it shows that moving away from no government situation would boost the GDP growth through establishment of property rights, providing public goods, etc. On the other hand, excessively large government size, ceteris paribus, reduces the growth due to the needs to increase taxes to finance these expenditures, distortion of incentives, and so on (Bajo-Rubio, 2000).

Barro (1990), in an influential work, points out that a raise in taxes due to increase in the government spending would reduce the growth rate. On the other hand, this increase in the public expenditure would increase the marginal productivity of capital which in turn would raise the growth rate of the economy. According to him, the effect of government expenditure on growth is not monotonic; that is, as the government size increases, its positive effect declines. Consequently, a large public sector would get in the way of economic growth. Tanninen (1999), Dar and Amirkhalkhali (2002), and Chen & Lee (2005), among others, confirm this point of view.

Vedder and Gallway (1998) using the USA data over 1947-1997 found that the optimal size of government/GDP that maximizes the economic growth is 17.45%. They also estimated the optimal government as a percent of GDP for Canada, Denmark, Italy, Sweden, and the UK. The results show that the optimal level is 21.37%, 26.14%, 22.23%, 19.43%, and 20.97% of GDP, respectively. Chao and Grubel (1998) showed that the optimal size of government in Canada during 1929-1996 was 27% which was almost close to the government size that Vedder and Gallway (1998) have found for Canada.

Fölster and Henrekson (2001) studied the relationship between the government size and the economic growth on a sample of rich countries covering the period 1970-1995. The results show that the there is a strong negative relationship between these variables and a 10 percentage points increase in public sector size causes a one percentage point reduction of the growth rate. The authors used an extensive robustness tests and showed that these results are quite robust. Illarionov and Pivovarova (2002) studied the optimal size of government in OECD countries during the period 1960-2000 and found that an increase in the government size would result in a reduction of the average growth rate of these countries.

Pevcin (2004) studied a set of EU countries and found that the optimal size of government in Finland and France is 39% and 43% of GDP, and it is 38.5%, 45%, and 37% for Germany, Netherlands, and Italy, respectively.

Chen and Lee (2005) using a threshold approach introduced by Hansen (2000) analyzed the existence of an Armey curve in Taiwan. They provide some evidence of existence of the Armey curve in the Taiwanese economy. The threshold size of the government, when defined as "total government expenditure divided by GDP" found to be 22.8% of GDP. However, when they defined government size as "government consumption expenditure divided by GDP" they show that the optimal size of the government is 15% of GDP. Alexiou (2007) studied the relationship between the public expenditure and the economic development in Greece during 1970-2001 and showed that there is a positive connection between the government spending and the economic growth in

Greece.

Magazzino (2008) studied the Armey curve for Italy during 1862-1998 and the post world war II period (1950-1998) and concluded that the optimal size of government is 23.1% and 32.8%, respectively. Alexiou (2009) is another study that uses data from seven transition economies in the south eastern Europe to analyze the connection between the government spending and the economic growth. He used data over 1995-2005 and showed that the government spending on capital formation has a significant and positive effect on the economic growth in these countries. In 2009 Lizardo and Mollick examined the effect of government consumption on economic growth in 23 Latin American countries. Using data over 1974-2003, they showed that the government size in most of these countries has passed the optimal size, i.e. 13.7% of GDP. In other word, they showed that an increase in the government consumption causes a decrease in the growth rate.

Chobanov and Mladenova (2009) studied the optimum government size for a sample of 81 countries and showed that the optimal size of government consumption is 10.4% of GDP. In addition, for OECD countries they showed that the government size should not be larger than 25% of GDP. Using a panel of EU countries, Mutaşcu and Miloş (2009) showed that the optimal size for the government in the EU-12 and EU-15 countries are 27.5% and 30.4% of GDP.

Forte and Magazzino (2010) studied 27 EU countries and applying time series approach have found that there is a negative relationship between public expenditure and growth rate in these countries. Afonso and Furceri (2010) analyzed the effect of total public revenue and expenditure on economic growth for a set of OECD and EU countries over 1970-2004. The results indicated that there is a negative relationship between the size of government and the economic growth. Ekinci (2011) using the notion of a normal distribution tried to find an optimal government size for the European countries, the US, and the UK during 1997-2008. He showed that the optimal government size is 13.4% and it should not be higher than 31.7% to stimulate the economic growth.

As it can be seen the results from the previous studies are inconclusive.

Sheehey (1993), Vedder and Gallaway (1998), and Chen and Lee (2005) are among the scholars who think the reason for the inconclusive results might be the existence of some forms of nonlinearity between these variables. And different empirical studies have confirmed the existence of nonlinear relationship between the government size and the economic growth.

In this paper we study the existence of an Armey curve in Greece; mainly because, the recent economic crisis in Greece has forced the Greek government to take austerity measures by cutting its expenditure to control the budget deficits and also the debts, but these actions bring up a very important question. Would these austerity measures, aimed at reducing the government size, harm the economic growth or not? To answer this question, we need to know whether the government size before these actions were higher than the optimal level or lower than that. If we could show that the government size was larger than the optimum size, then these actions not only will not harm the economic growth but also it would help the economy to recover faster.

To that end, instead of relying on a second degree polynomial regression, which is quite popular in the literature, we use a smooth transition logistic regression which is more flexible than the second degree polynomial models. In fact, the latter is a special case of the former when a third-order Taylor approximation is applied. These models not only capture the sudden jumps or breaks in the data but also they have the possibility of detecting the smooth transitions and changes. Using data over 1961-2008 we estimated a threshold level for the government size in the Greece. The estimated threshold for the government size (general government consumption expenditure as a percent of GDP) is 13.26%. The results confirm that there is a nonlinear connection between the government size and the economic growth; however, the results do not verify the existence of the Armey curve in Greece because the government size has a positive effect on the economic growth in both regimes. A percentage point increase in the government size leaded to a 0.004 and 0.011 percentage point increases in the Greek growth rate in the regime 1 and 2, respectively.

The remainder of the paper has organized as follows. Next section describes the methodology of the smooth transition regression models. In section 3 the data and the empirical results are provided and section 4 concludes the paper.

2 Methodology

The smooth transition models are originated in the work of Bacon and Watts (1971) and extended by many researchers including Granger and Teräsvirta (1993), Franses and van Dijk (2000), and van Dijk et al (2002). The standard STR model can be shown as follows:

$$y_t = \phi' z_t + \theta' z_t G(\gamma, c, s_t) + u_t, \qquad t = 1, 2, ..., T \tag{1}$$

where z_t is a vector of explanatory variables which consists of the lagged values of y_t and other explanatory variables. ϕ and θ show the parameter vectors in the linear and nonlinear parts, and $u_t \tilde{} iid(0, \sigma^2)$. In addition, $G(\gamma, c, s_t)$, shows the transition function. It is a bounded function of the transition variable, s_t, the vector of location parameters, c, and γ which is the slope parameter and shows the speed of the regime change.[3] The time trend, any of the explanatory variables in z_t, the lagged values of z_t or any other variable could be selected as the transition variable of the model. In addition, the STR model turns into a TR (threshold regression) model when the $\gamma \to \infty$ and it becomes a linear model when the $\gamma \to 0$.[4]

In this paper we assume that the transition function is a logistic function

$$G(\gamma, c, s_t) = (1 + \exp\{-\gamma \prod_{k=1}^{K} (s_t c_k)\})^{-1}, \qquad \gamma > 0, c_1 \leq c_2 \leq ... \leq c_k \tag{2}$$

which means that we use a logistic STR (LSTR) model. K shows the number of regime changes that happen and $K = 1$ and $K = 2$ are the most common selected values.[5] If $K = 1$ the parameters change from ϕ to $\phi + \theta$ and the model has the possibility of capturing an asymmetric behavior of the data. On the other hand, when $K = 2$, the parameters in the equation (1) change around the mid-point $(c_1 + c_2)/2$, symmetrically and the behavior of the variable in both ends, i.e. small and large values of s_t, are similar. The location parameter shows the point of regime change and at the location point $G = 0.5$.

The first step in the estimation of the LSTR model is to specify a linear model and select the optimal lag, which can be done using the information criteria such as Akaike (AIC) or Schwarz (SBC) information criteria. Which of course, economic theories can be used to specify the linear model and choose the variables that are needed to be entered in the model. Next, it is necessary to test the null hypothesis of linearity against the presence of a nonlinear relationship between the variables.[6] If the transition variable is unknown, then the test has to be repeated for every potential transition variables. If the null cannot be rejected in any case, then we conclude that the linear model in appropriate and there is no need to proceed with STR models. However, if the null hypothesis gets rejected for any transition variable, then the model builder must use a STR model to capture the full behavior of the time series. If the null can be rejected in favor of the STR models more than once, then the model with the strongest rejection (lowest $p-$value) is selected to be estimated.

Due to presence of unidentified nuisance parameters under the null hypothesis, it is not possible to use the conventional Lagrange Multiplier (LM) to test the null. To overcome this problem, Luukkonen, Saikkonen, and Teräsvirta (1988) have proposed a method based on the third-order Taylor expansion of the transition function. In addition, since the transition variable is unknown at this stage, the test statistic is calculated for different candidates of transition variables, the transition variable that has the smallest p-value of the linearity test is selected as the transition variable.[7]

The parameters of the model depend on the c and γ and since the model is estimated through an nonlinear optimization, it is necessary to use an adequate initial values for the c and γ. In order to decrease the sensitivity of the results to the initial values, it is possible to use a grid search approach to find the best values for the c and γ. For each values of these two parameters the square sum of the residuals (SSR) of the model can be calculated and the values with the minimum SSR is selected as the initial values of the c and γ. After having a good starting values for these parameters, the model can be estimated using different algorithms.

Like any other models in econometrics, the estimated STR model must be evaluated using misspecification and diagnostic test such as the no error autocorrelation, no additive nonlinearity, parameter constancy, ARCH, and the like.

3 Empirical results

In order to test the existence of the Armey curve in Greece we use annual data of GDP growth rate (EG) and general government consumption expenditure as a percent of GDP (GS) as an indicator of the government size over 1961-2008. These data are obtained from the WDI[8] (2010) and are shown in the Figure 2.

We test for stationarity of the data using ADF and ADF type test of Saikkonen and Lütkepohl (2002) which allows for one unknown structural break. The results which are presented in Table 1 show that the EG is stationary without a structural break; however, the GS becomes stationary when we allow for a structural break. This break point is determined endogenously and it happens in 1975. Since we have some evidence of stationarity for both variables we may use the data without differencing.

The first step in the estimating the STR models is to specify an adequate linear model and determine the number of lagged variables that needs to be entered into the model in order to capture the processes' dynamic. Since in this paper we want to test the existence of the Armey curve in Greece, in the model we only include the GS and the lagged values of EG and GS as explanatory variables. We use AIC and SBC information criteria which both determine 1 as the optimal lag. Next, we test the null of linearity against the alternative hypothesis of STR model. The estimated F-statistics, reported in Table 2, indicate that the null of linear relationship between the variables can be rejected at 1% level of significance. In addition, based on these results the highest F belongs to GS_t, so we consider it as the transition variable.[9]

Now, having determined the transition variable we can estimate the model. To obtain adequate starting values for the γ and c, we use a two-dimensional grid search using 30 values within the rages $[0.5, 10]$ and $[9, 19]$, respectively. The selected initial values for γ and c are 5.966 and 13.205. The results of the reduced model based on these initial values are presented in Table 3. To get the model for regime 1, we put $G = 0$ and also we put $G = 1$ to get the model for the regime 2 as followings:

$$\begin{array}{ll} EG_t = 0.066 - 0.404EG_{t-1} - 0.049GS_t + 0.053GS_{t-1} & \text{for regime 1} \\ EG_t = -0.152 + 0.350EG_{t-1} + 0.005GS_t + 0.006GS_{t-1} & \text{for regime 2} \end{array} \tag{3}$$

$$\begin{aligned} pLM_{ARCH}(1) &= 0.385, \qquad pLM_{Normality} = 0.559 \\ pLM_{AR}(1) &= 0.787, \qquad pLM_{AR}(4) = 0.290 \quad . \end{aligned} \tag{4}$$

The sum of the GS coefficients in the regime 1 and 2 are 0.004 and 0.011, respectively, which show that the government size has a positive effect on the GDP growth in Greece in both regimes. That is, a one percentage point increase in the GS had increased the EG by 0.004 and 0.011 percentage points, respectively, in the first and the second regime. In other words, the results show that as the government size increases, during the period of study, the growth rate of economy increases as well.[10]

In sum, the results show that the government intervention in the economy has stimulated the Greek economy and since the estimated threshold is 13.26%, therefore, the government size should never be lower than 13.26% of the GDP in Greece. Figure 3 illustrates the estimated logistic transition function against the transition variable, i.e., GS. The estimated γ is equal to 6.077 which indicates that the regime change in the Greece has occurred slowly; in other words, it shows that the government size slowly affected the economic growth. In addition, more information are provided in the Figure 4 through showing the estimated transition function plotted against observations. Based on this figure we can see that the regime 2 consists of the period 1977 to 2008. The original and fitted series are plotted in the Figure 5 to show that the model can capture the dynamic of the time series process.

As mentioned before, the effect of the government size on the economic growth increases as the government size increases; that is, the GS has an increasingly positive effect on EG. In other words, we can say that the government size in Greece has not reached the turning point where the diminishing returns of scale starts and the effect of the government size becomes negative. Notice that the maximum GS during the period under study is 18.297 which has occurred in 2003 and it does not seem to be that high compare to other countries such as Sweden and Netherlands.[11]

In sum, the results of this paper provide some evidence of nonlinear relationship between the government size and the economic growth in Greece; however, this nonlinear relationship is not an inverted U-shaped. In fact, the results show that the relationship between these variables is more similar to a J curve. Therefore, even though the results are in line with the endogenous growth theories, because there is a link between the government spending and the economic growth, but the existence of Armey curve in Greece cannot be confirmed.

4 Conclusion and Policy implication

Following the notion of the Armey curve, we use annual data of the government size and the economic growth in Greece over 1961-2008 to study the nonlinear relationship between these variables. We test for the existence of a threshold effect between the government size and the economic performance using a smooth transition regression model. In this model the transition between the regimes, after and before the threshold, is explained by a logistic function; and the popular binomial equation used in the literature to test the existence of Armey curve is a special case of these smooth transition regression models.

The results show that there is a positive relationship between the government size and the economic growth in Greece. This is consistent with the results of Alexiou (2007) which studied the connection between the government expenditure and the growth in the Greek economy. In addition, the positive effect of government size on the growth rate is higher when the government size is larger than 13.26% of the GDP. That is, there is a nonlinear relationship between the variables; however, this relationship resembles a J curve not an inverted U-shape. Consequently, the results do not confirm the existence of Armey curve in Greece.

Since the results show that the government expenditure has a stimulation effect on the economic growth in Greece, the austerity measures introduced, recently, by the Greek government would act as an economic growth impeding. Consequently, the government needs to adopt and design different policies to ease the negative effect of these austerity measures on the economy.

References

[1] Afonso, A., Furceri, D., 2010. Government Size, Composition, Volatility and Economic Growth. *European Journal of Political Economy* 26 (4), 517–532.

[2] Alexiou, C., 2007. Unraveling the 'Mystery' Between Public Expenditure and Growth: Empirical Evidence from Greece. *International Journal of Economics* 1(1), 21-31.

[3] Alexiou, C., 2009. Government Spending and Economic Growth: Econometric Evidence from the South Eastern Europe (SEE). *Journal of Economic and Social Research* 11(1), 1-16.

[4] Armey, D., 1995. T*he Freedom Revolution*. Washington: Regnery Publishing.

[5] Bacon, D. W., Watts D.G., 1971. Estimating the Transition Between Two Intersecting Lines. *Biometrika* 58, 525–534.

[6] Bajo-Rubio, O., 2000. A further generalization of the Solow growth model: the role of the public sector. *Economic Letters*, 68, 79-84.

[7] Barro, R.J., 1990. Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy* 98(5), 103-125.

[8] Chao, Johnny C. P., Grubel, H., 1998. Optimal Levels of Spending and Taxation in Canada. In Herbert Grubel, eds. How to use the fiscal surplus Vancouver: The Fraser Institute, 53-68.

[9] Chen, S.T., Lee, C.C., 2005. Government size and economic growth in Taiwan: A threshold regression approach. *Journal of Policy Modeling* 27, 1051-1066.

[10] Chobanov, D., Mladenova, A., 2009. What Is the Optimum Size of Government. Institute for Market Economics, August, Sophia, Bulgaria.

[11] Dar, A.A., Khalkhali, S.A., 2002. Government size, factor accumulation, and economic growth: evidence from OECD countries. *Journal of Policy Modeling* 24(7-8), 679-692.

[12] Ekinci, A., 2011. What is the optimal size of government: A suggestion. *International Journal of Economics and Finance Studies* 3, 45-54.

[13] Engen, E., Skinner, J., 1992. Fiscal Policy and Economic Growth. NBER Working Paper No. 4223.

[14] Fölster, S., Henrekson, M., 2001. Growth effects of government expenditure and taxation in rich countries. *European Economic Review* 45(8), 1501-1520.

[15] Franses, P.H., van Dijk, D., 2000. *Nonlinear Time Series Models in Empirical Finance*. Cambridge: Cambridge University Press.

[16] Friedman F., 1997. If Only the U.S. Were as Free as Hong Kong, *Wall Street Journal*, July 8, p. A14.

[17] Ghali, K.H., 1998. Government size and economic growth: Evidence from a multivariate cointegration analysis. *Applied Economics*, 31, 975-87.

[18] Granger, C.W.J., Terasvirta, T., 1993. *Modelling Nonlinear Economic Relationships*. Oxford: Oxford University Press.

[19] Hansson, P., Henrekson, M., 1994. A new framework for testing the effect of government spending on growth and productivity. *Public Choice* 81, 381-401.

[20] Illariov A., Pivovarova N., 2002. Size of Government and Economic Growth. *Voprosy Economiki* 9, 40-41.

[21] Kormendi, R. C., Meguire, P., 1986. Government debt, government spending, and private sector behavior: Reply. *American Economic Review* 76(5), 1180-1187.

[22] Lizardo, R., Mollick, A.V., 2009. Can Latin Ameica prosper by reducing the size of government?. *Cato Journal* 29, 247-266.

[23] Lütkepohl, H. and Krätzig, M. (eds.), 2004. *Applied Time Series Econometrics*. Cambridge Books, Cambridge University Press.

[24] Luukkonen, R., Saikkonen, P., Ter■svirta, T., 1988. Testing linearity against smooth transition autoregressive models. *Biometrika* 75, 491-499.

[25] Magazzino, C., 2008. Modeli interpretation della dinamia della spesa pubblica e curva di Armey: il caso italiano 1862-2001 in *Notizie di Politieia*. a XXIV 92, 45-60.

[26] Magazzino, C., Forte, F., 2010. Optimal Size of Government and economic groth in EU-27. *MPRA Paper* 26669.

[27] Mutaşcu, M. and Miloş, M., 2009. OPtimal size of government spending. The case of European unition countries. *Annales Universitatis Apulensis Series Oeconomica* 11, 447-456.

[28] Pevcin, P., 2004. Size of Budgetary and non-budgetary Government: explaining Cross-country Differences, *Working Paper*, Univerza v Ljubljuni, Slovenia.

[29] Ram, R., 1986. Government size and economic growth: A new framework and some evidence from cross-section and time-series data. *American Economic Review* 76(1), 191–203.

[30] Saikkonen, P., Lutkepohl, H., 2002. Testing for a Unit Root in a Time Series with a Level Shift at Unknown Time. *Econometric Theory* 18, 48-313.

[31] Sheehey, E., 1993. The effect of government size on economic growth. *Eastern Economic Journal*,19(3), 321-328.

[32] Tanninen, H., 1999. Income Inequality, Government Expenditures and Growth. *Applied Economics* 31,17-1109.

[33] van Dijk, D., Teräsvirta, T. and Franses, P.H., 2002. Smooth Transition Autoregressive Models — A Survey Of Recent Developments. *Econometric Reviews* 21(1), 1-47.

[34] Vedder, R., Gallaway, L., 1998. Government Size and Economic Growth. *Joint Economic Committee*. Available at www.house.gov/jec/.

Notes

[1]In addition, the negative effect of public programs expenditures on saving and capital accumulation is documented in the literature, see Fölster and Henrekson (1999) and Chao and Grubel (1998).

[2]Friedman (1997) states that the optimal level of government size would be somewhere between 15% and 50% of GDP and beyond that the growth rate declines.

[3]The location parameters show the time points that the transition takes place and a regime change happens.

[4]In other words, the STR models do nest the linear models; therefore, a researcher can start from a linear model and extend the model to a nonlinear case if it found to be necessary.

[5]We consider these two cases in this paper.

[6]It worth noting that, this null hypothesis is identical to the null that states $\gamma = 0$ or $\theta = 0$.

[7]A detailed description of the STR models can be found in the chapter 6 of the Lütkepohl and Krätzig (2004).

[8]World development indicators

[9]All the estimations are carried out using the JMulti.

[10]We estimated the model using per-capita data and the results were very close to the results presented here. These results are available upon request.

[11]The GS for Sweden and Netherlands reach up to 30% and 25% of their GDP.

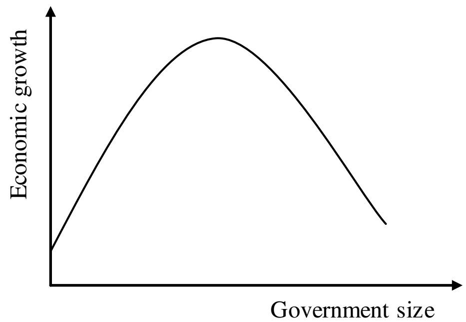

Figure 1: The Armey Curve

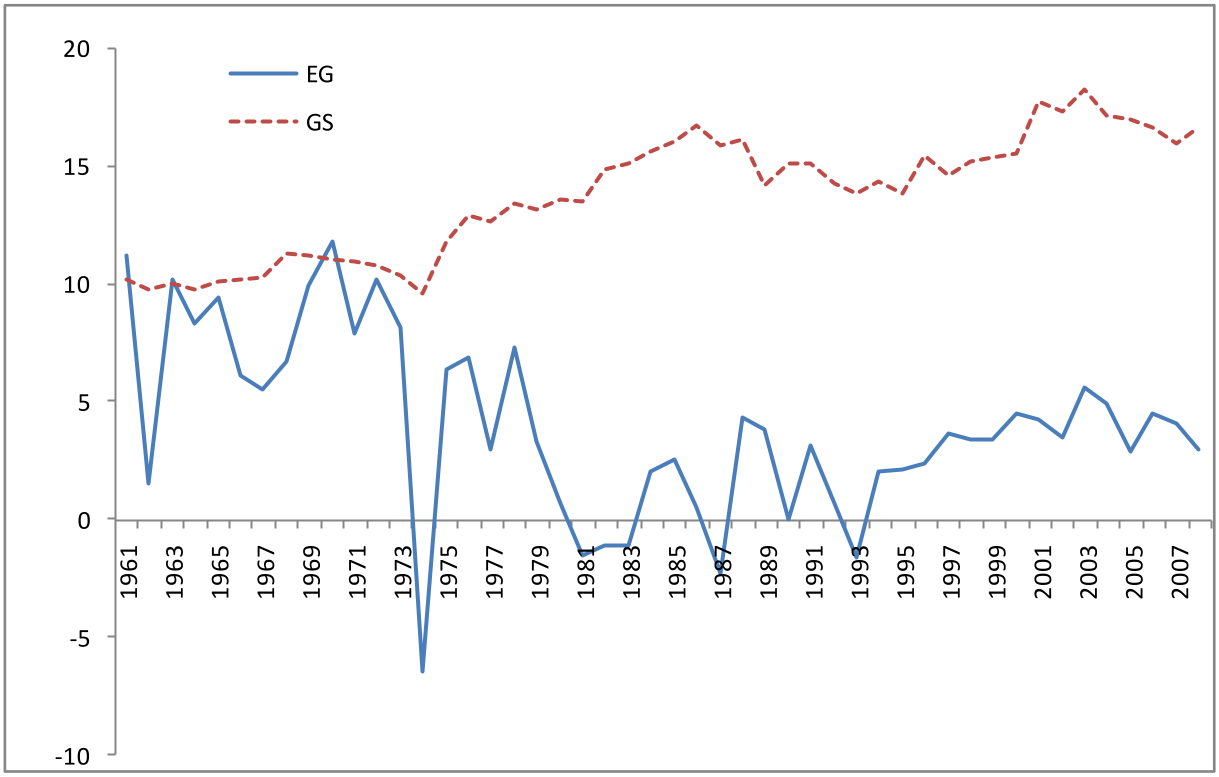

Figure 2: The plot of the GDP growth rate (EG) and general government consumption expenditure as a share of GDP (GS).

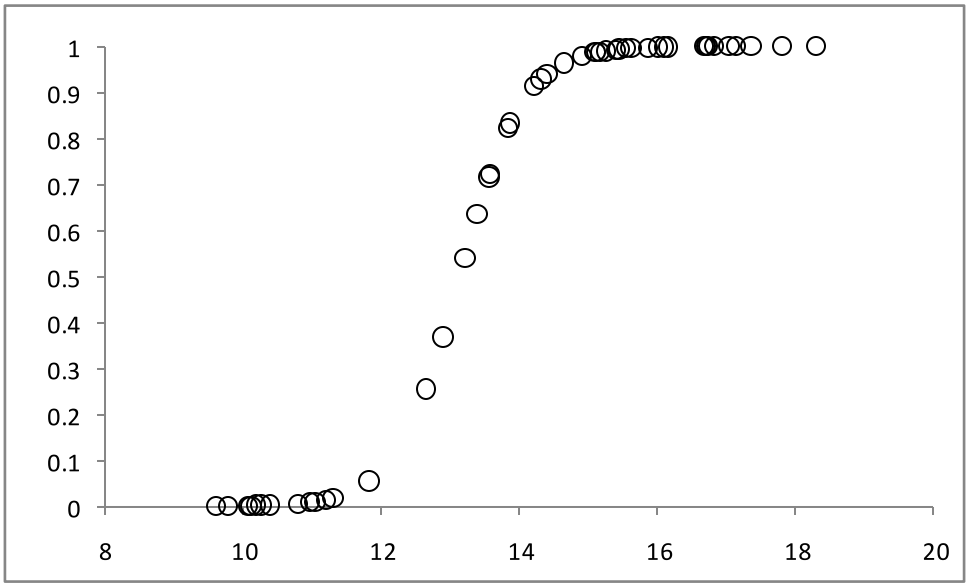

Figure 3: Transition function as a function of the transition variable. Notice that observations are shown by the circles and each circle might corresponds to more than one observation.

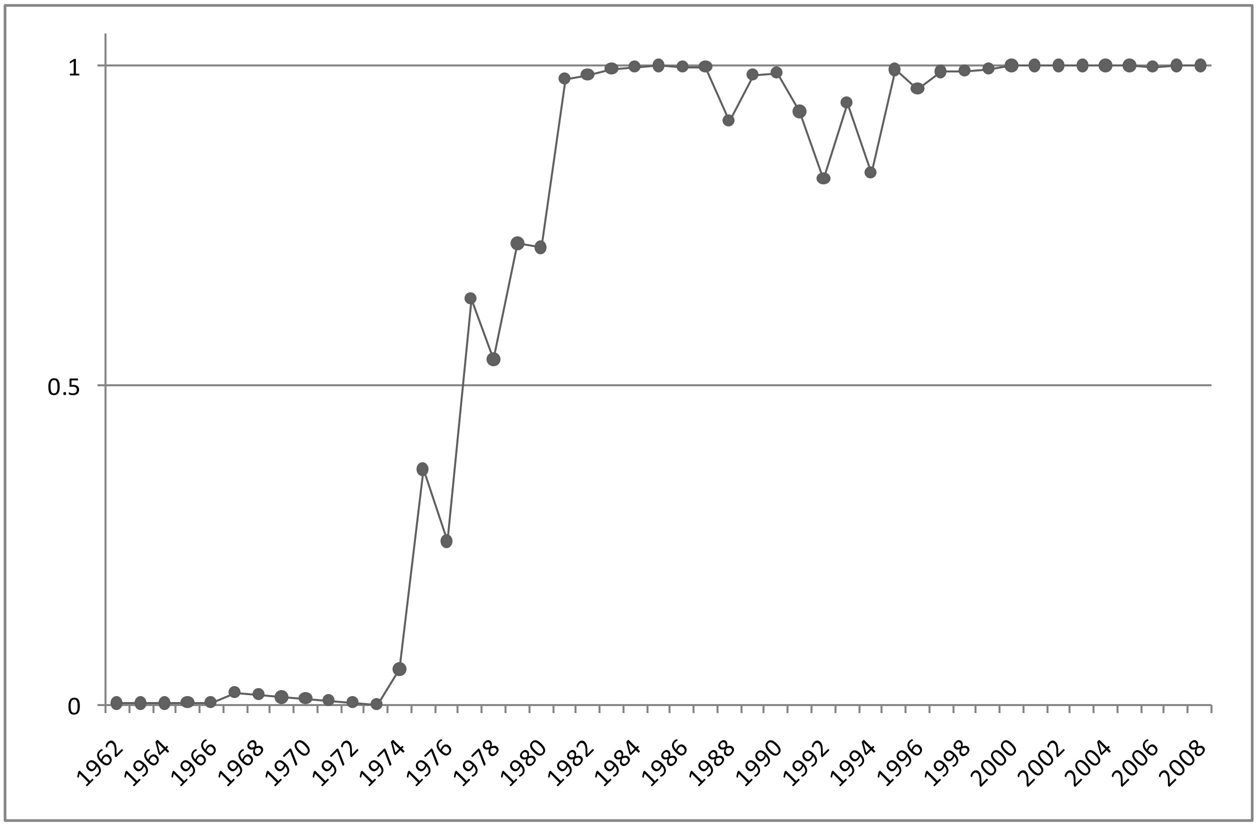

Figure 4: Transition function as a function of observations. Each observation is shown by a circle.

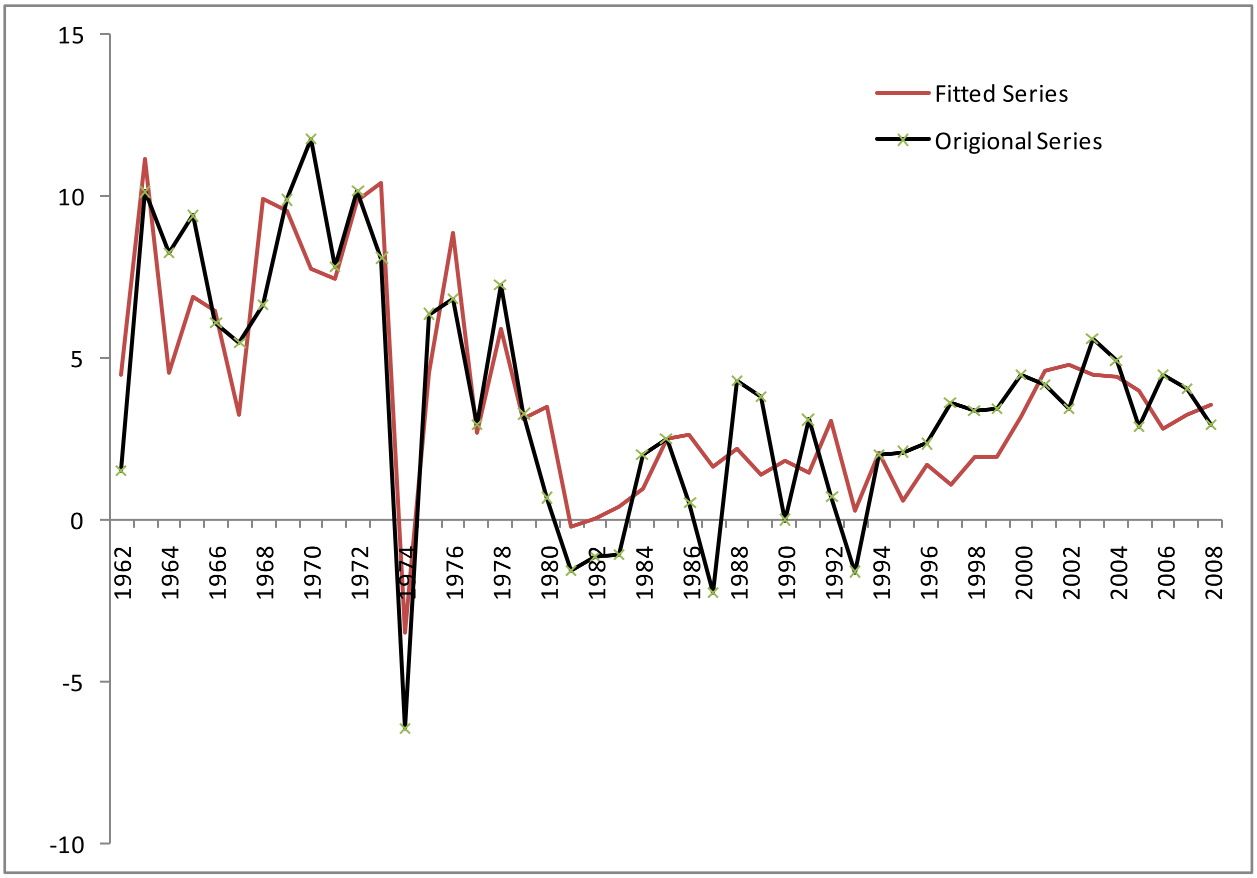

Figure 5: The origional and fitted series.

Table 1: The results from the unit root test.

	ADF			Saikkonen & Lütkepohl (2002)
	none	c	c & t	c & t
EG	-1.591*	-4.682**	-4.995**	
GS	0.924	-1.251	-2.519	-2.955*
* and ** show significance at the 10% and 1%, respectively. The estimated break point for the GS is 1975.				

Table 2: The results of the linearity tests against the STR model.

Transition Variable	F	Suggested Model
EG_{t-1}	8.82E-03	LSTR1
GS_t*	3.72E-05	LSTR1
GS_{t-1}	2.23E-04	LSTR1
Trend	3.77E-04	LSTR1
The figures show the p-values of F-test. The suggested transition variable is shown by an asterisk.		

Table 3: The estimation results of the STR model.

	Linear Part	Nonlinear Part
Constant	0.066 (0.528)	-0.218** (-1.673)
EG_{t-1}	-0.404* (-2.118)	0.754* (2.516)
GS_t	-0.049* (-5.147)	0.054* (4.508)
GS_{t-1}	0.053* (5.101)	-0.047* (-3.869)
Gamma	6.077	
C1	13.259	
Adjusted R^2	0.741	
The t-statistics are shown in the parentheses. * and ** show the significance at the 5% and 10%, respectively.		