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An Investigation of the Impact of Size of the Government on Economic Growth: Some New Evidence from OECD-NEA Countries[1]

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Abstract

Achieving economic growth, as one of the essential purposes in each country, needs appropriate tracing of government as one of the important and effective sections in that economy. Nowadays, unlike the 80s, economists concentrate on objectives such as explanation of the relationship between size of the government and economic growth and delineation of optimum size of the government which causes maximum level of economic growth. But, notwithstanding widespread studies had not caught the unique result about of this theme. This paper is conducted with the purpose of examining the impact of size of the government on economic growth in selected OECD-NEA countries over the period of 1990-2011 and uses the Panel Smooth Transition Regression (PSTR) model in the form of Cobb– Douglas equation function as it is applied in Dar and Amir Khalkhali (2002) to remove the existent problems in previous studies and offering reliable results in frame of comprehensive and integral model. The results of the study strongly reject the linearity hypothesis and estimate two regimes that give a threshold in size of the government of 28.27 percent to gross domestic production (GDP) for selected countries. Moreover, the impact of size of the government on economic growth is positive for both regimes. But, the intensity of it is low in high levels of size of the government. So, the results of this study express that the big govenment size is as a brake for high levels of economic growth in selected countries under investigation. Also, the impacts of investment, labor force, and export on economic growth have been evaluated as positive in two regimes of the non-linear model.

Keywords: Economic Growth, Panel Smooth Transition Regression (PSTR) Model, Selected OECD Countries, Size of the Government.
JEL Classification: O4, O1, N1, C23.

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1. Introduction

Achieving high rate of economic growth is one of the fundamental objectives for each country. The government as an important and effective sector in the economy is a prerequisite for this purpose. As particularly, interest in economic growth has always been at the center of the literature in development economics (Dar & Amir Khalkhali, 2002). Milestone of recent studies on this theme is Armey curve which explains a non-linear relationship between size of the government and economic growth including a maximum point which is viewed as the optimal size of government to cause high level of economic growth. Therefore, among the factors that determine the economic growth, government spending is of particular interest in this research, as we investigate the effect of government consumption expenditure to GDP ratio that is widely seen as having an important role in supporting economic growth besides government investment spending, by concentrating on the probability of existence of non-linear relationship between the growth variables.

The relationship between economic growth and government spending has been examined by many empirical and theoretical studies using various testing approaches. Barro (1990) believes that government investment expenditure in public infrastructure is an important objective for economic growth. While, the fiscal policies and government consumption spending by this investment expenditure to come off infrastructures have been regarded as necessary (see Zagler & Durnecker, 2003; Hemming et al., 2002).

The size and activity of governments can affect economic growth in positive and negative ways. The positive effects may happen due to providing public goods and substructures and the negative impacts through the crowding-out effect of government monopolistic activities.

Also, the lower levels of government spending stress to fewer revenues are needed to achieve balanced budgets, which means that lower taxes can be levied, therefore contributing to stimulate growth and employment. This taxation burden can be ineffective on growth (Easterly & Rebelo, 1993; Daveri & Tabellini, 2000; Romer & Romer, 2007; Furceri & Karras, 2009).

On the other hand, government spending and revenue is viewed as having a marginal role in promoting economic growth and budgetary balances. So, the control of fluctuations of government expenditures is viewed as an important objective in each country. As it can be seen in some studies (Easterly & Rebelo, 1993; Daveri & Tabellini, 2000; Romer & Romer, 2007; Furceri & Karras, 2009), very high level of taxes has negative effects on economic growth. Thus, balanced budget requires fewer government spending and revenues. This occurs by levying lower level taxes that can stimulate growth and employment. On the other hand, Aschauer (1989.a),

Munnel (1990), and Evans & Karras (1994) found that higher level of public spending often occurs with higher growth rates, while, Folster & Henrekson (2001), Bassanini et al. (2001), and EC (2006) confirm that higher size of the government is associated with lower growth rates.

Adam Smith and Jean-Baptiste Say, as classical economists, oppose the government's intervention and believe that without the government's intervention and with assumption of supple prices, wages and interest rate and adjustment in the labor market causes the market forces to swiftly bring the economy to the long-run equilibrium (self-regulating mechanisms in the economy).

Although, the Neoclassical growth model as formulated by Solow (1956), does not prescribe the influence channels of government activities in long-run growth and stresses that government policies can only affect sustainable equilibrium level and growth in the short-run, the new growth theorists debate about fiscal policies in new growth models and express that there is temporary and long-run effect from government intervention during the transition to equilibrium, and from government spending on economic growth, respectively.

Keynes, as the earliest person who deemed economic role for government by introducing unemployment in macroeconomic, states that non-equilibrium is removable by government's intervention and monetary and financial policies. In heavy recession position, crowding out effect is very low and increases by moving economy to perfect employment as all production impacts of governments expansionary financial policies go in perfect employment level; prices and interest rates increase stead production rising. But, government can take interest rate under control by setting off relative variables and applying suitable monetary and financial policies. On the one hand, Freedman believes that effectual role of government for decreasing unemployment rate in the short-run can intervene in economy by increasing the spending and financial security of it through bank system that causes increase of inflation rate and thereby decrease of real wages.

On the other hand, others stress that reduction of military government spending does not necessarily increase economic growth. But this type of expenditure can cause economic growth by expanding the aggregate demand (the Keynesian effect) which causes applying of otherwise idle capitals, increase in profits, investment, and employment, also by extension human capital through providing education and vocational and technical training (Benoit, 1973, 1978).

Moreover, the relationship between economic growth and government activities is confirmed by Tanzi's theory (see Tanzi & Zee, 1997).

There are different arguments about the impacts of government activities on economic growth: some believe that government inefficiency, the excess burden of taxation, rent-seeking behavior, corruption, etc. have negative impact on growth. While others confirm that government activities affect economic growth with positive impacts through beneficial externalities, through the development of a legal, administrative, economic infrastructure, and interventions to offset market failures, etc. (see, e.g., Ram, 1986; Tanzi & Zee, 1997). Moreover, some oppose the ultra-size of government and believe in the ineffective role of very big or small governments on economic growth under the results of linear models and by considering the various degrees of size of the government indices (see, e.g., Anaman, 2004; Kuştepeli, 2005; Mavrov, 2007). Others, such as Chandra (2004), stress the unfavorable impact of the big government investment spending. Other empirical studies have documented a negative impact of a larger government on growth (see, e.g., Barro, 1991; Barro & Sala-i-Martin, 1995; Mavrov, 2007).

On the one hand, negative impact of government consumption, government investment, and total expenditures on economic growth has been demonstrated by some studies (Ramayandi, 2003; Chandra, 2004; Lopez, 2008; Gregoriou & Ghosh, 2009; Sjöberg, 2003; Pevcin, 2004; Butkiewicz & Yanikkaya, 2011). Others have confirmed the promoting roles of government consumption spending, investment spending, and total expenditure on economic growth (Albatel, 2000; Lim, 2000; Sjöberg, 2003; Doessel & Valadkhani, 2003; Yasin, 2003; Loizides & Vamvoukas, 2005; Yuk, 2005; Gregoriou & Ghosh, 2009).

Other works on the analysis of government-growth nexus suggest various results in developed countries, particularly OECD members. Folster & Henrekson's (2001) study of 23 countries from OECD members applying growth rates of GDP and labor force, investment to GDP, government taxation revenues to GDP, total government spending to GDP, and rate of human capital growth variables in panel data framework with fixed effects, has concluded the positive relationship between variables and economic growth except government taxation revenues to GDP and size of the government variables.

However, Heitger (2001), by extending the neoclassical model and using panel data approach with random effects, has concluded the negative impact of government spending and rate of labor force growth on economic growth and negative relationship between private investment and size of the government in the same year for 21 countries from OECD members over the 1960-2000 period.

Alfonso & Furceri (2008) analyzed 15 OECD members over the 1970-

2004 period by panel data with fixed effects approach. They concluded the negative impact of government consumption spending and subsides, excise, and financial support from people on economic growth. They also argue that private investment and government investment spending have positive and inactive effect on economic growth, respectively.

By recent studies that have tried to survey the non-linear relationship of government and growth, the results for OECD countries indicate that among 23 countries from OECD members, the long-run optimal size of the government varies between 29% and 54%. (c.f. De Witte & Moesen,[1] 2010). Wahab (2011), comparing economic growth's behavior in OECD and non-OECD countries, argues the positive impact of government total and investment spending on economic growth when expenditure growth is below trend-growth. But the impact of government consumption spending is appraising negative by him.

As it can be seen, the different models and theoretical and empirical studies about the impact of size of the government on economic growth have not achieved a single result for expressing the relationship between these variables. Indeed, some studies accent the existence of non-significant relationship and many others refer to significant positive or negative relationship between size of the government and economic growth. One of the main reasons of different results about this issue can be the existence of non-linear relationship between these variables.

The existence of such repugnance in many studies is the reason of insufficiency in presenting unique theorem and universal or specific rule for various countries which can arise from governmental-economical qualification and used experimental and theoretical models for representing the nexus. Therefore, the necessity of researching and testing linearity of the relationship between size of the government and economic growth for each country, particularly OECD members is sensed.

The set of countries under our survey concludes the NEA[2] countries belonging to the OECD that have rather similar economical-structural position of contain industrialized and developed economies and also 90% of global nuclear electricity generating capacity. Again the NEA member's governments have some missions such as deciding on nuclear energy policy,

1. They conclude the optimal average government involvement amounts to 41% of GDP in Armey curve standard and using nonparametric Data Envelopment Analysis (DEA) framework.
2. The OECD-Nuclear Energy Agency (NEA) members countries in the sample are the following: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

and to broader OECD policy analyses in areas such as energy and sustainable development to provide authoritative assessments and to forge common understandings on key issues.

Thus, it can affect government's financial position in the long term in these countries, which may lead to considerable share of government spending veer to government investment expenditures to respond these policies' costs. This is natural that the government consumption expenditures are impressed in its result and also these conversions affect economic growth process of them in the long-run.

So, this paper provides new evidence about the impacts and consequences of size of the government on economic growth, applying production function developed by Dar & Amir Khalkhali (2002) and non-linear testing for the relationship of variables under investigation. We also examine the validity of positive impacts of government consumption spending - as the result of some linear studies for these set of economies - in Panel Smooth Threshold Regression (PSTR) model which permits a smooth transition as a weak number of thresholds, as for a continuum of regimes.

The structure of the paper is organized as follows: the next section contains the model specification and data of this research. In Section 3, the empirical results are presented and finally, Section 4 concludes the paper.

2. Econometric Methodology and Data Description

Our sample is consisted of data for 30 countries from OECD-NEA members over the 1990–2011. Based on the various studies which precisely debate non-linearity between size of the government and growth, the size of the government as the source of the nonlinear size of the government-growth nexus is known. On the other hand, Armey (1995) implements the Laffer curve to present the nonlinear relationship between size of the government and economic growth that are empirically founded by Sheehey (1993), Vedder & Gallaway (1998), and Chen & Lee (2005), then introduces inverted U-shaped Armey curve.

Moreover, according to the literature review, there are many different studies with different results about the role of government in economic growth. But these studies do not present a unique sign for displaying the impact of size of the government on economic growth. Thus, there is probability of existence of non-linear relationship between these variables that leads us to survey this issue. Analysis of Armey (1995) about this issue is that low government spending can increase economic growth until it reaches a certain level that is called threshold size of the government. But high level of government spending reduces economic growth. Indeed, he

believes in the positive impact of government in supplying public goods and infrastructure causes improvement in economic growth, but maintains other government activities in economy, such as additional projects financed by the government that become increasingly less productive, is undesirable to economic growth because of negative impact of excess infrastructure on marginal benefits.

Indeed, the big size of the government contributes in output's reduction by diminishing the constructive features of government's intervention through adverse effects of further expansion of government (Herath, 2012).

Note that not only the various studies about analyzing the non-linearity between government expenditure and growth are not precisely stratified in various and or equal income levels economies, but also that they represent different results about inverted U-shape of Armey curve that is much known in this theme. Whereas, the existence of other different linear or non-linear relations between government expenditure and growth that can present best-fit from the relationships of variables is very probable. Regarding the use of linear approaches to delineate the relationship between variables, most of the studies have applied the same models and econometric methodologies (see, e.g., Folster & Henrekson, 2001; Heitger, 2001; Dar & Amir Khalkhali, 2002; Yasin, 2003; Kuştepeli, 2005; Alfonso & Furceri, 2008; Lopez, 2008; Gregoriou & Ghosh, 2009; Wahab, 2011) which have created various conclusions on the issue even for similar economies.

Also, as in some works, the different degrees for size of the government indicator is considered (Anaman, 2004; Kuştepeli, 2005), others have surveyed only the quadratic equation form for their model under investigation in order to answer the inverted U-shape of Armey curve (see, for instance, Pevcin, 2004). But, the downright rest to Armey curve or surveying the different degrees for size of the government indicator will be very cramp, particularly by referring to this considerable mention that some researchers and economists are not unanimous about the existence of U-shape curve for express of this nexus.

On the one hand, most of the studies ignore the high probable existence of heterogeneity in gross domestic production data of various countries and select the individual effects and there are on fixed or random effects approaches- notwithstanding the individual effects and time effects- which causes spurious regressions estimations. However, assuming that coefficients of the observed explanatory variables are identical for all observations will not be rational for decrypting the response of economic growth to variation of government expenditure in various economies, particularly in various income levels and economical structures countries.

Therefore, analyzing the existence of nonlinear nexus between effective variables in output function and thereupon economic growth using the model that includes most of these variables resolves extant main problems of other prior studies and presents reliable results, too. In this study, the introduced integral model by Dar & Amir Khalkhali (2002) applying PSTR models approach has perused. Total factor productivity growth is considered as one of the main variables beside other effective variables such as capital and labor force in this model that can be prevented from biased models specification because of ignoring of effective variables in government consumption-growth nexus. The algebraic form of the model is as follows:

$$\mathbf{GY_{it} = \beta(GK)_{it} + \theta\,(GL)_{it} + A_{it}} \quad (1)$$

$$\mathbf{A_{it} = \mu_i + \alpha(GS)_{it} + \rho(GX)_{it} + u_{it}} \quad (2)$$

$$\mathbf{GY_{it} = \mu_i + \alpha(GS)_{it} + \beta\,(GK)_{it} + \theta\,(GL)_{it} + \rho\,(GX)_{it} + \varepsilon_{it}} \quad (3)$$

where GY**GY** is percentage of annual growth rate of GDP (2000 prices base), GS**GS** is size of the government (real government consumption spending to real GDP ratio percent), GK**GK** refers to the annual growth rate of fixed capital formation to GDP ratio as a proxy of investment growth rate, and GL**GL** and GXand **GX** are the annual growth rate of employment labor force to adult population (+15 years) ratio percent and annual growth rate of real exports, respectively. Moreover, A_{it}**A_{it}** measures the rate of total factor productivity growth. Note that the residual ε_{it} is assumed to be **i.i.d. N (0, δ_{ε}^2)** and u_{it} refers to the individual fixed sections effect. The subscripts **i(i = 1, 2, . . . , n)** and **t(t = 1, 2, . . . , T)** index the countries and time periods in the sample, respectively.

The Panel Smooth Threshold Regression (PSTR) model with extreme regimes can be viewed as prominent regime-switching model that is the generalization of the threshold panel model of Hansen (1999). Not only the model permits a smooth transition, as a weak number of thresholds for a continuum of regimes, and does not impose a restrictive function form to relation of variables, but also it can proximate modeling the probable nonlinear relationship between variables, by transition function and base of threshold variables observations. However, heterogeneous time and sectional effects are specified in other simple panel models, the changing the estimated coefficients across individuals and over time is possible in frame of PSTR model which heterogeneity problem of estimated parameters is resolved in this trough.

The PSTR model was proposed by Gonzàlez et al. (2005) and Fok et al. (2004) and then developed by Colletaz & Hurlin (2006). In order to

investigate the relationship between variables under investigation the simplest case of this model which suppose the existence of two extreme regimes and a single transition function is as follows:

$$\begin{aligned} GY_{it} &= \mu_i + \alpha_0 GS_{it} + \beta_0 GK_{it} + \theta_0 GL_{it} + \rho_0 GX_{it} \\ &+ \left[\alpha_1 GS_{it} + \beta_1 GK_{it} + \theta_1 GL_{it} + \rho_1 GX_{it}\right] G\left(q_{it};\gamma,c\right) + \varepsilon_{it} \end{aligned} \quad (4)$$

The transition function $G(q_{it};\ \gamma, c)$ is a continuous function which depends on the value of threshold variable q_{it} and is normalized to be bounded between 0 and 1. Gonzàlez et al. (2005), adopting Smooth Transition Autoregressive Regression (STAR) models introduced by Granger & Terasvirta (1993) and Jansen & Terasvirta (1996), specified the logistic form of transition function as follow.

$$G\left(q_{it};\gamma,c\right) = \left[1 + \exp\left(-\gamma\prod_{i=1}^{m}(q_{it} - c_j)\right)\right]^{-1}$$
$$\gamma > 0,\ c_1 \le c_2 \le,\ldots,\le c_m \quad (5)$$

where $c = (c_1, \ldots, c_m)'$ is as the vector of threshold parameters or locations of occurrence of regime-switching. The parameter γ determines the slope of the transition function.

According to theoretical studies, the government consumption spending is different from government investment spending, structurally. Although consumption expenditure besides investment expenditure occurs at about the same time, government consumption expenditure- unlike investment expenditure- can have ineffective impacts on output growth in some times. Since composition and the impact type of them will be different in varying periods, considering the total government expenditure to GDP ratio as a proxy of size of the government to delineate the impact of it on output growth causes the unreliable results to deciding about government financial policies. Thus, we have to use the government consumption spending to delineate its impacts on growth.

Gonzalez et al. (2005) believe that considering one or two threshold values (m=1 or m=2) will be enough in order to specify the variability of parameters. They stress that for m=1 the model PSTR implies that the two extreme regimes are associated with low and high values of q_{it} with a single monotonic transition of the coefficients from $\alpha_0, \beta_0, \theta_0, \rho_0$ to $\alpha_0 + \alpha_1$, $\beta_0 + \beta_1$, $\theta_0 + \theta_1$ and $\rho_0 + \rho_1$ as q_{it} increases, where the change is centered around c_1. If $\gamma \to \infty$, $G(q_{it};\ \gamma, c)$ the PSTR model in (4) reduces to the two-regime panel threshold regression (PTR) model of Hansen (1999). Indeed, when $q_{it} > c_1$, the transition function $G(q_{it};\ \gamma, c)$ attains the value 1 and 0 otherwise.

For m=2, the minimum of transition function is at $(c_1 + c_2)/2$ and attains the value 1 both at low and high values of transition variable (q_{it}). If $\boldsymbol{\gamma \to \infty}$, the count of regimes raise to a three-regime whose outer regimes are identical and different from the middle regime. But, when $\boldsymbol{\gamma \to 0}$ for any value of m, the transition function $\mathbf{G(q_{it};\ \gamma, c)}$ becomes constant and the model collapses into a homogenous or linear panel regression model with fixed effects (Gonzalez et al., 2005).

Gonzalez et al. (2005) and Colletaz & Hurlin (2006) have introduced a testing process to investigate the existence or inexistence of non-linear relationship between variables under investigation that presents a context to creating reliable final estimation of PSTR by using Non-Linear Least Squares (NLS) approach that is equivalent of Maximum Likelihood estimator.

Since the surveying of linearity in PSTR under $\mathbf{H_0: \gamma = 0\ \ or\ H_0: \alpha_1 = \beta_1 = \theta_1 = \rho_1 = 0}$ will have unidentified nuisance parameters, the associated tests will be nonstandard. Therefore, to circumvent the identification problem, it is necessary that $\mathbf{G(q_{it};\ \gamma, c)}$ is replaced in (4) by its first-order Taylor expansion around $\boldsymbol{\gamma = 0}$ which can be viewed as the testing of equivalent hypothesis in auxiliary regression (Gonzalez et al., 2005). Thus, Taylor expansion for the PSTR model with n threshold is as follow:

(6)

$$\begin{aligned}\mathbf{GY_{it}} &= \mu_i + \alpha_0 \mathbf{GS_{it}} + \beta_0 \mathbf{GK_{it}} + \theta_0 \mathbf{GL_{it}} + \rho_0 \mathbf{GX_{it}} + \tau_0(\alpha_1 \mathbf{GS_{it}} \\ &+ \beta_1 \mathbf{GK_{it}} + \theta_1 \mathbf{GL_{it}} + \rho_1 \mathbf{GX_{it}}) + \tau_1 \mathbf{q_{it}}(\alpha_1 \mathbf{GS_{it}} + \beta_1 \mathbf{GK_{it}} + \theta_1 \mathbf{GL_{it}} \\ &+ \rho_1 \mathbf{GX_{it}}) + \ldots + \tau_n \mathbf{q_{iti}^n}(\alpha_1 \mathbf{GS_{it}} + \beta_1 \mathbf{GK_{it}} + \theta_1 \mathbf{GL_{it}} + \rho_1 \mathbf{GX_{it}}) + \mathbf{u_{it}}\end{aligned}$$

Due to the $\boldsymbol{\tau_n}$ parameters is proportionate with $\boldsymbol{\gamma}$ parameter of transition function, the testing of linearity under $\mathbf{H_0: \tau_1 = \ldots = \tau_n = 0}$ and $\mathbf{H_1: \tau_1 \neq \ldots \neq \tau_n \neq 0}$ is possible. The Wald Lagrange Multiplier, Fischer Lagrange Multiplier and likelihood ratio coefficients are as the criteria in process of testing. The testing of remaining non-linearity on PSTR model to determination of the count of necessary transition functions for specifying of PSTR model is the next stage after support of existence the non-linearity nexus between the variables. The null hypothesis $\mathbf{H_0}$ of this test is the existence of one transition functions, while the alternative hypothesis $\mathbf{H_1}$ is the existence of at least two transition functions for PSTR model. The second transition function in Taylor expansion access specifies is as follow:

$$GY_{it} = \mu_i + \alpha_0 GS_{it} + \beta_0 GK_{it} + \theta_0 GL_{it} + \rho_0 GX_{it} + \tau_0(\alpha_1 GS_{it} + \beta_1 GK_{it} + \theta_1 GL_{it} + \rho_1 GX_{it}) + (\alpha_1 GS_{it} + \beta_1 GK_{it} + \theta_1 GL_{it} + \rho_1 GX_{it}) g_1(q_{it}; \gamma_1, c_1) + \tau_0(\alpha_2 GS_{it} + \beta_2 GK_{it} + \theta_2 GL_{it} + \rho_2 GX_{it}) + \tau_1 q_{it}(\alpha_2 GS_{it} + \beta_2 GK_{it} + \theta_2 GL_{it} + \rho_2 GX_{it}) + \cdots + \tau_n q_{it}^n(\alpha_2 GS_{it} + \beta_2 GK_{it} + \theta_2 GL_{it} + \rho_2 GX_{it}) + u_{it} \quad (7)$$

3. Empirical Results

3.1. Stationary of Data

We use IPS (2003) and LLC (1992) tests to investigate the stationary of data. The results in Table 1 indicate that the variables under investigation are stationary.

Table 1. Results of unit root tests.

variable	IPS test		LLC test	
	W statistic	Prob.	t statistic	Prob.
GY	-8.299	0.000	-8.854	0.000
GS	-3.330	0.001	-3.405	0.000
GK	-9.377	0.000	-8.793	0.000
GL	-8.445	0.000	-8.813	0.000
GX	-8.181	0.000	-9.397	0.000

* Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Null: Unit root (assumes common unit root process).

Source: result of study (EViews software).

3.2. Linearity Tests

The results of linearity tests between the variables considering the size of the government indicator as the threshold variable of model are presented in Table 2.

Table 2. Linearity test and the number of regimes testing: result of tests for Remaining Non-Linearity on PSTR model.

	m=1			m=2		
	LM_w	LM_F	LR	LM_w	LM_F	LR
$H_0: r=0 \text{ vs } H_1: r=1$	25.65 (0.000)	6.73 (0.000)	27.30 (0.000)	28.15 (0.000)	3.67 (0.001)	30.16 (0.000)
$H_0: r=1 \text{ vs } H_1: r=2$	1.36 (0.851)	0.30 (0.875)	1.36 (0.850)	3.83 (0.872)	0.42 (0.905)	3.87 (0.869)

Notes: The testing procedure to delineate the number of regimes is beginning with first stage that survey the linear model (r=0) against a model with one transition function (r=1), which continues by testing the single transition function against a double transition functions (r=2) providing the rejection of null hypothesis. The procedure resumes until the alternative hypothesis is not rejected.

Source: results of study (MATLAB software).

The results of non-linearity test presented in Table 2 suggest the rejection of the linearity hypothesis. According to result of this test, one number of transition functions is sufficient to assess the non-linearity between size of the government and economic growth; because the information of three criteria suggest that a model with one transition functions would be better than a model with two transition functions.

3.3. Determination of the Number of Location Parametr

The process of determination of the optimal number of thresholds in the transition function is stood in the next non-linearity scrutiny's stage to choose one model from a model with one threshold and other model with two thresholds by transition function, which its results are presented in Table 3.

Table 3. Determination of the Number of Location Parameters

	qit=GS	
Criteria	**r=1 , m=1**	**r=1 , m=2**
RSS	1756.4	1738.4
AIC	1.025	1.020
Schwarz	1.093	1.095

Source: results of study (MATLAB software).

The residual sum of squares and the AIC and Schwarz are as three criteria to capture single result about the optimal number of thresholds in the transition function. If these criteria do not lead to the unique result, the Schwarz criterion is known as reliable criteria to determination of location parameters. The results suggest that one transition function with one threshold is optimal (r =1, m =1).

3.4. Estimation Results of PSTR Model and Discussion

Table 4 contains the parameters' estimates of the final PSTR models, the estimated slope parameter ($\boldsymbol{\gamma}$) that refers to velocity of transition from first regime to second regime is estimated as 19.59 $\mathbf{19.59}$. On the other hand, the estimated location parameter for size of the government has estimated 28.27% $\mathbf{28.27}$ of GDP. Indeed, this location parameter is as the point of reference for discerning of the two said regimes of PSTR model. Thus, the estimated parameter for each variable alters from one regime to other.

Based on the results of study, the impact of size of the government on economic growth is positive and significant in two regimes. But the intensity of this positive impact in second regime is lower than to first regime. This implies the fatal effect of size of the government on economic growth in high levels of size of the government. It is natural that high percentage of

government consumption spending to GDP ratio associates with low percentage of government investment spending to GDP ratio which will can promote the economic growth in the long-run or at least after some cycles (dilatory impacts of government investment spending).

Moreover, whereas devoted labor force could be very effectual in high levels of size of the government (as this scenario is confirmed by empirical results in other studies), the positive impacts intensity of investment and export on growth has decreased in high level of size of the government. The reasons for this issue are that the volume of private investment falls down resulting adverse effect of high size of the government for investment could well reflect the crowding-out effect as well as inefficiency resulting from the excess burden of taxation (Dar & Amir Khalkhali, 2002) to response the high government consumption spending. On the other hand, reduction in government productive activities causes falling of favorable impact's intensity of these factors on economic growth rather than its volume in low levels of size of the government too[1].

Moreover, the growth rate of exports has positive impact on growth in low levels of size of the government; that its intensity has slaked in high levels of size of the government. This implies the high efficiency of export revenues occur in high levels of government productive activities.

On the other hand, the impact of size of the government on economic growth is positive for both regimes. But, the intensity of it is low in high levels of size of the government. So, the results of this study express that the big govenment size acts as a brake for high levels of economic growth in selected countries under investigation- like get empirical results from other studies for selected OECD countries (c.f., Alfonso & Furceri, 2008).

1. The Keynesian view stresses on the positive effect of government spending on the expectations of the investors (Aschauer, 1989.b: 178-179; Baldacci et al., 2004). On the one hand, most researchers believe that the effect of different categories of government expenditure will be various. Whereas infrastructure government investments such as expenditure on roads and electricity may be complement of private investment through increase the productivity of the private sector and also incentive of private investors to investment (see e.g., Olison, 1984; Aschauer, 1989; Monadjemi, 1995; Serven, 1998).

Table 4. Estimation Results of PSTR

variables	parameters	coefficients (t statistic)
GS	α_0	3.228 (3.641)
	α_1	0.215(-1.971)
GK	β_0	19.746 (8.654)
	β_1	-16.824 (-3.363)
GL	θ_0	0.313 (4.025)
	θ_1	1.125 (5.242)
GX	ρ_0	0.146 (5.625)
	ρ_1	-0.055 (-1.979)

$$G(q_{it};\ \gamma, c) = 0:$$

$$\mathrm{GY_{it}} = \alpha + 3.22\ (\mathrm{GS})_{\mathrm{it}} + 19.74(\mathrm{GK})_{\mathrm{it}} + 0.31(\mathrm{GL})_{\mathrm{it}} + 0.14(\mathrm{GX})_{\mathrm{it}} + \mathrm{u_{it}}$$

$$G(q_{it};\ \gamma, c) = 1:$$

$$\mathrm{GY_{it}} = \alpha + 3.01(\mathrm{GS})_{\mathrm{it}} + 2.92(\mathrm{GK})_{\mathrm{it}} + 1.44\ (\mathrm{GL})_{\mathrm{it}} + 0.09(\mathrm{GX})_{\mathrm{it}} + \mathrm{u_{it}}$$

$$\gamma = 19.595 \qquad c = 3.342\ (antilog = 28.27\ \%\ \mathrm{GDP})$$

Notes: The t statistics in parentheses are based on Corrected Standard Errors. The values in brackets are the standard deviations. γ , c refer to estimated slope parameter and estimated location parameter, respectively.

Source: results of study (MATLAB software).

Finally, trace of variables is introduced by diagram forms in order to round the empirical results and better expression of PSTR model. Figures 1 and 2 indicate the trace coefficients of growth rate of gross fixed capital formation to GDP ratio and ratio of labor force to adult population on economic growth, respectively. Moreover, Figures 3 and 4 indicate the trace coefficients of growth rate of real exports and government consumption spending to GDP ratio on economic growth, respectively. Figure 3 manifests the conversions of intensity of positive impacts of export revenues and Figure 4 unveils the various intensity of impacts of government consumption expenditure on economic growth in different volumes of size of the government.

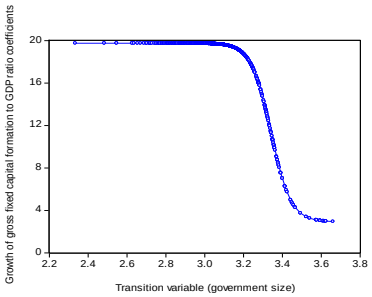

Fig. 1. The trace coefficients of growth rate of gross fixed capital formation to GDP ratio on economic growth

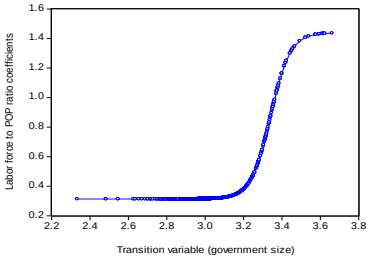

Fig. 2. The trace coefficients of labor force to adult population on economic growth

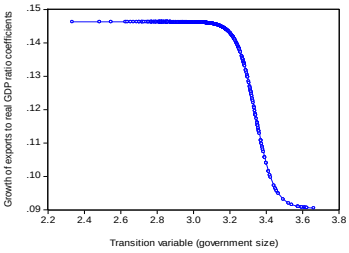

Fig. 3. The trace coefficients of growth rate of real exports on economic growth

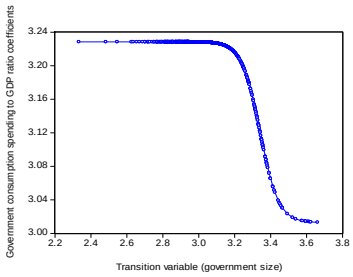

Fig. 4. The trace coefficients of government consumption spending to GDP ratio on economic growth

4. Conclusion

Economic growth reflects the overall performance of a society, and economists have concentrated on topics such as the optimal size of governments as effective part in each economy can promote economic growth. This paper, applying a different approach, has tried to unveil the main reasons of various results of previous studies which have caused different arguments about the impact of government activities on economic growth. As with empirical evaluation of the influence of various variables on the size of the government-growth nexus, and applying a Panel Smooth Threshold Regression specification, and also investigating non-linearity between the variables under investigation, it is concluded that there is a non-linear relationship between size of the government and economic growth that can be bound by economic variables such as size of the government, investment, labor force and export.

Based on the PSTR model results, estimated location parameter for regime-switching of model is 28.27 (%real GDP is 28.27 (% real GDP).). Moreover, the results indicate that the intensity of positive impacts of investment and export on growth has decreased in high levels of size of the government that points to decreasing of favorable impact of these factors on economic growth resulting reduction in government and private investment, reduction employed labor force ratio resulting high tax burden - to response to high volume of government consumption expenditures - and also raising wages because of high productivity in high levels of consumption expenditure and hence decreasing private consumption and aggregate demand.

As the main result of study, it can be remarked that the big govenment size is as a brake for high levels of economic growth in selected countries under investigation - like getting empirical results from other studies for selected OECD countries (c.f. Alfonso & Furceri, 2008). Moreover, our reliable results do not assent with inverted U-shaped curve for size of the government-growth nexus.

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