DOES GOVERNMENT SIZE MATTER FOR ECONOMIC GROWTH? A NON-LINEAR ANALYSIS USING STATE SPACE MODEL.

Nermeen Harb [a,b*] AND Stephen G. Hall [a]

[a] Department of Economics, University of Leicester, UK

[b] Department of Economics, Zagazig University, Egypt

Abstract

There is a doubt in the economic theory regarding the impact of government size on economic growth. Therefore, this study aims to examine the relation between government size and economic growth from a non-linear perspective. We employ panel data for 5 selected countries within the Middle East and North Africa region for the period 1970-2014. This study introduces a new approach of estimating Panel Smooth Transition Regression (PSTR) model in the structure of State Space system equations. Our empirical analysis provides an evidence for the presence of a threshold level for government size (18.125% of GDP) below which it affect economic growth negatively.

Keywords: Government size, Non-linearity, PSTR, State Space model.

JEL code: C22, C23, H11, H50.

[*] Correspondence to: Nermeen Harb, Department of Economics, University of Leicester, University Road, Leicester, LE1 7RH, United Kingdom and Zagazig University, Egypt.

Email: nermenharb@gmail.com

# 1. INTRODUCTION

Does expanding government size have a deleterious or flourishing impact on economic growth? Despite the presence of a controversial debate among scholars on how government size affects economic growth, we can build a convincing argument in each case. The theoretical literature offers an evidence for both positive and negative effect of government size on economic growth. Some researchers confirm that government should intervene in the economy in order to develop the legal, administrative, economic infrastructure and to avoid market failure (e.g. Ram, 1986). On the contrary, others argue against such governmental intervention. As it has a destructive impact on economic growth in the long run due to excess burden of taxation, unproductive use of resources and crowding out effect (e.g. Cameron, 1982; Landau, 1983). However, Kormendi and Meguire (1985) find no evidence that government consumption adversely affect economic growth. Afterwards, Barro (1990) introduced a non-monotonic relationship between government size and economic growth.

Theoretically, there exist two different points of view concerning the role of government in economic growth. The first is the neoclassical growth theory introduced by Solow (1956) and the second one is the endogenous growth theory developed by Romer (1986) and (Lucas 1988). The former suggests that there is no government; they assume that growth take place due to exogenous technological change. Therefore, in the long run, government policy does not have any impact on economic growth. However, it may have a temporary effect on growth during the transition of the economy to its steady state (Pevcin, 2004).

On the other hand, the latter theory argues that long-run economic growth is determined endogenously. The endogenous growth theory's main conclusion is that government policy affects a country's growth performance in the long run (Dar and AmirKhalkhali,(2002)). The endogenous growth theory sees, also, the role of government from a different perspective and, hence, it allows for a non-linear relationship between government expenditure and economic growth. Barro (1990) argues that an increase in taxes due to a rise in government spending has a detrimental effect on economic growth. However, a boost in public expenditure accelerates marginal productivity of capital which, in turn, leads to an increase in rates of economic growth. Therefore, he introduces the presence of a non-monotonic relationship between government expenditure and economic growth.

Later, Armey (1995) introduced an inverted U-Shaped curve (Armey Curve) in order to explain the relationship between government size and economic growth. Since, in a world without government, there will be no rule of law and no protection of property rights. Therefore, moving away from a no government situation would lead to an increase in the growth rate of GDP. However, as government grows, the law of diminishing returns holds; this is because of the increase in taxes to finance expenditures. Therefore, when keeping other variables constant, an enormous increase in government expenditures leads to a decline in rates of economic growth.

Existing empirical studies, which investigate the relationship between government size and economic growth, present inconclusive results. This is a result of most of these studies using linear models and ignoring the possibility of a non-linear relationship between government size and economic growth (e.g. Dar and AmirKhalkhali, 2002; Afonso and Furceri, 2010; Hanson and Henerkson, 1994). Also, very few empirical studies examine the relationship between government size and economic growth from a non-linear perspective (e.g. Christie, 2012; Chen and Lee, 2005). These studies argue that, above a certain threshold level, government size has a deleterious impact on economic growth. However, there is no clear consensus about the optimal size of government expenditures.

In order to assess the Barro non-linear hypothesis, Christie (2012) applies a threshold regression (PTR) model for a panel of 136 developing and developed countries during the period from 1971 to 2005. Moreover, he employs a GMM-estimation technique in order to control the simultaneity bias in government size and the economic growth nexus. His empirical results show evidence of the presence of a threshold level of government size of 33% of GDP. Accordingly, above this threshold level, government size has a negative effect on economic growth. Furthermore, he provides evidence for additional sources of non-linearity from level of economic development and quality of government.

Along the same line Pevcin (2004) claim the presence of Armey curve for 12 European countries[2]. He Find an optimal threshold government size range between 36 and 42 percent of GDP. In the same context, Pushak et al., (2007) examine the non-linearities between government size and economic growth. They introduce institutional quality as one of the most important determinants of growth. Their results, using OLS, fixed and random effect, confirm that above a certain threshold level, public spending has a negative effect on rates of economic growth while, below this level, it has insignificant impact on rates of growth.

Interestingly, Davies (2009) investigates the optimal size of government consumption expenditure and its effect on social welfare instead of GDP. He employs dynamic GMM for a panel of 154 countries and uses Human Development Index (HDI) as a measure of social welfare. Hence, he argues that it is better to use HDI since it allows him to differentiate between standard of living and income. According to his empirical analysis, he reveals that optimal government size with respect to HDI is higher than optimal government size with respect to GDP.

A few studies assert the hypothesis of nonlinearity between government size and economic growth using various time series data and employing different approaches (e.g. Grossman, 1988; Mittnik and Neuman, 2003; Chen and Lee, 2005). On the other hand, other cross-section studies could not prove this hypothesis (e.g. Kelly, 1997; Afonso and Furreci, 2010). Hence their tendency was just to employ quadratic term of government size (Christie, 2012).

Apparently most of the foregoing studies offer contradictory evidence. Indeed the discrepancy in results may relate to different econometric approaches, samples and indicators for both government size and economic growth. Further they failed to capture the non-linearity between government size and economic growth due to using

[2] Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Sweden and United Kingdom.

inappropriate methodological frame work. Moreover, we believe that pooling both developed and developing countries might be questionable. As there exist a difference in the composition of government expenditures between both types of countries. Thus the optimal size of government spending will vary among these countries. Because most of government expenditures in developing countries are directed toward infrastructure and education which might promote economic growth in the long run; however, in case of developed countries public expenditures aims to improve social welfare (Yavas, 1998). Therefore integrating both developed and developing countries might lead to biased estimates.

The above discussion shows a clear fact that there exists undoubtedly an interesting gap in the literature. However, in developing countries, there is still a very limited investigation of the relationship between government size and economic growth. Hence, most of the previous studies are concerned only with industrialized countries (e.g. OECD countries) and overlook developing countries. Herath (2012) confirms the importance of analysing the relationship between government size and economic growth in developing countries. This is because most of these countries suffer from unstable political situations and poverty which stimulates governments to take part in the economy and spend money through welfare expenditure.

Similarly Abu-Bader and Abu-Qarn (2003) suggest that these countries suffer from large fiscal imbalances due to high expenditures. Moreover, their government revenues are very sensitive to any external shocks, growing population and sustained per capita rates of economic growth are considered to be a major challenge. Specifically, this study aims to answer the following questions: 1) how does government size affect economic growth? 2) Does optimal size of government spending exist? 3) How large should the government be in the Middle East region?

This study extends the existing literature in several ways: firstly, our study attempts to answer the above mentioned questions by using a newly developed estimation technique for one of the most well-known threshold models (STAR model) and by using Sate Space system equations. Secondly, the developed model supersedes and overcomes the limitation of previous studies in determining endogenously a precise and significant threshold value. As previous studies limitation stem from employing a quadratic term which impose a particular form of nonlinearity that fail to capture the true impact, while others determine the threshold level exogenously. Thirdly, we developed the model itself to estimate two different threshold variables jointly; this is a new contribution to the literature. Fourthly, to the best of our knowledge, this is the first study to investigate the relationship between government size and economic growth in the MENA region from a non-linear perspective covering the long time span from 1970 to 2014.

The rest of this paper is organized as follows: section 2 discusses the methodology used in this study and defines both the PSTR and state space model and illustrates how we define PSTR model in the form of state space equations. Section 3 explains the data employed in this study. Section 4 analyzes our empirical results and the final section,5 presents our conclusion.

## 2 Methodology:

Our main objective is to examine the non-linearity hypothesis between government size and economic growth. Accordingly, we estimate the threshold level of government size and explore its impact on economic growth below and beyond the threshold level. In this context, we define a Panel Smooth Transition Regression (PSTR) approach in the form of a state space system. The state space model allows us to determine endogenously the threshold value of government size. We believe that this model provides a new insight to the threshold effects of the government size and economic growth relationship. This is because the state space model has the advantage of estimating two different threshold variables; for instance, we estimate simultaneously the threshold level of inflation and government size. In other words, the model is flexible which allow for different transition coefficients and, furthermore, we can impose an econometric restriction by restricting all transition coefficients to be the same. In the following sections, we explain the PSTR model briefly; illustrate the state space model; and, finally, we demonstrate how to define the PSTR model in the form of state space equations.

### 2.1.1 Panel smooth transition regression approach:

The PSTR model was developed by Gonzalez et al., (2005); it is considered to be a fixed effect model with exogenous regressors. It is defined as a nonlinear homogenous panel model. Furthermore, it is a linear heterogenous panel model with coefficients differing across individuals and across time. Heterogeneity is allowed by supposing that coefficients are a continuous function of an observable variable through a bounded function of this variable; this is named the transition function which oscillates between a limited numbers of regimes.

The simple PSTR model with two extreme regimes is defined as:

$$y_{it} = \mu_i + \beta_0' x_{it} + \beta_1' x_{it}\, g\,(q_{it}; \gamma, c) + u_{it} \qquad (1)$$

For $i$ = 1,….,N, and t = 1,….,T, where N and T indicate the cross section and time dimensions of panel data respectively. The dependent variable $y_{it}$ is a scalar representation of the annual rate of growth of GDP for five developing countries, $\mu_i$ presents the fixed individual effect, $x_{it}$ is a dimensional vector of time varying exogenous variables and, lastly, $u_{it}$ represents the error term. The transition function g ($q_{it}$; γ, c) is defined as a continuous function of an observable variable $q_{it}$[3]; this is restricted between 0 and 1. These two values are correlated with the regression coefficients $\beta_0$ and $\beta_0 + \beta_1$. While γ locates the smoothness of transitions between regimes, c indicates the threshold parameter. According to Gonzalez et al., (2005), Granger and Teräsvirta (1993), the general form of logistic transition function (i.e. LSTAR) is defined as follows:

$$G\,(q_{it}; \gamma, c) = \left(1 + exp\left(-\gamma \prod_{j=1}^{m} (q_{it} - c_j)\right)\right)^{-1} \text{ with } \gamma > 0 \text{ and } c_1 \leq c_2 \leq \ldots \leq m \qquad (2)$$

c $= (c_1, \ldots\ldots, c_m)'$ is an m-dimensional vector of location parameters while $\gamma > 0$ and $c_1 \leq c_2 \leq \ldots \leq$ m represent the imposed restrictions. In the case of m=1, the model displays that two extreme regimes are correlated with low and high values of $q_{it}$. If γ

[3] Threshold variable is individual specific and time varying

$\rightarrow \infty$, the logistic transition function becomes an indicator function I[A]; this take value 1 when A occurs or 0 otherwise.

For m=2, the transition function g ($q_{it}$; γ, c) has a value of 1 at both low and high values of $q_{it}$ and attains its minimum value at $\frac{(c_1+c_2)}{2}$. In this state, if $\gamma \rightarrow \infty$, the model is a three-regime threshold model. Lastly, for any value of m if $\gamma \rightarrow 0$, the transition functions reduce to the linear panel regression model with fixed effects. According to Gonzalez et al., (2005), the building of the PSTR model is based on specification, estimation and evaluation stage.

In addition to the logistic function defined above (eq. 2), another exponential function can be defined in the context of the STAR model. Thereby, the transitional function is in the following format:

$$G(q_{it}; \gamma, c) = \left(1 - exp\left(-\gamma \prod_{j=1}^{m} (q_{it} - c_j)\right)\right)^2 \text{ with } \gamma > 0 \text{ and } c_1 \leq c_2 \leq \ldots \leq m \qquad (3)$$

In this case, the model is defined as ESTAR. Similarly with LSTAR model, c represents the threshold parameter while γ displays the smoothness of transition among regimes.

### 2.1.2 State space model:

#### 2.1.2.1 General idea of state space models:

The State Space model[4] is a dynamic system which involves unobserved state variable. A broad range of linear and non-linear models can be addressed: these include regression models with changing coefficients; autoregressive moving average (ARIMA); and unobserved component models (Mergner, (2009)). State Space models are based on two sets of equations: measurement equations (signal or observation equation); and transition equations (state equation).

a) The Measurement equation: characterizes the relationship between observed variables (data) and unobserved state variables.

[4] Developed by Kalman (1960)

b) Transition equation is an equation which displays the dynamics of the unobserved state variables (Kim and Nelson, (1999)). According to Mergner (2009), Commandeur and Kooperman (2007), a state vector may include trend, seasonal, cycle and regression components plus an error term. The state variable and the unknown parameter have to be estimated from the data using maximum likelihood which can be obtained from the Kalman filter.

In the state space models, the unknown parameters comprise of equation parameters and the state variances which are known as hyperparameters. These hyperparameters are estimated by using an iterative procedure in order to maximize the likelihood value (Cuthbertson, Keith et al., (1992)).

A general state space model can be represented as follows:

Measurement equation: $Y_t = Z_t A_t + d_t + \varepsilon_t$ $\quad$ E $(\varepsilon_t) = 0$, Var $(\varepsilon_t) = H_t$ $\quad$ (4)

Transition equation: $A_t = T_t A_{t-1} + x_t + e_t$ $\quad$ E $(e_t) = 0$, Var $(e_t) = Q_t$ $\quad$ (5)

Where $Y_t$ is a vector of variables observed at time t with dimensions $(n \times 1)$, $A_t$ represents state vector of unobserved variables with dimensions $(m \times 1)$, $Z_t$ is a matrix which links the observed vector $Y_t$ and the unobserved $A_t$ with dimensions $(n \times m)$, $d_T$ is an $(n \times 1)$, while $\varepsilon_t$ is a vector of serially uncorrelated disturbances $\varepsilon_t \sim N(0, H_t)$. According to the transition equation, $T_t$ is an $(m \times m)$matrix, $x_t$ is an $(m \times 1)$ vector and $e_t$ represents serially uncorrelated disturbances $e_t \sim N(0, Q_t)$.

Other assumptions, such as the following, should be imposed to complete the State Space model specification: 1) $A_0$ has mean $a_0$ and covariance matrix $P_0$; and 2) the disturbance $\varepsilon_t$ and $e_t$ are not correlated with each other at any period of time and not correlated with the initial state. Therefore,

$$\forall (s, t) \qquad E(\varepsilon_t . e_s') = 0 \qquad (6)$$

$$\forall t \qquad E(\varepsilon_t . A_0') = 0 \qquad (7)$$

Harvey (1989) explains the Kalman filter as a recursive algorithm which calculates the optimal estimator of the unobserved component (state vector) at time t, and depends on accessible information at the same time t.

According to Cuthbertson, Keith et al., (1992), the Kalman filter does not estimate the unknown parameters; it calculates the one step ahead of prediction errors $v_t$ and their variance covariance matrix. Simply, the idea behind Kalman filter is that we have an initial value of $A_0$ and its covariance $P_0$. We assume that we know the values of ( $Z_t$, $H_t$, $T_t$, $Q_t$) and we observe $y_t$. Consequently, the Kalman filter employs all this information in order to provide an optimal estimator for the unobserved state $A_t$. According to Kalman, the optimal estimator is to use minimum mean square error. Additional assumptions should be imposed so that the error terms are distributed normally; afterwards, it provides the maximum likelihood estimator of $A_t$. Beside the estimation of either the unobserved part of the model (i.e. time-varying parameters) or the expectation variable (i.e. stochastic trend), the Kalman filter can estimate the parameters of the system (i.e. variances) in one operation. Thereby, it is considered to be a powerful instrument (Cuthbertson, Keith et al., (1992)).

Two types of models can be represented by using the Kalman filter. These are an unobservable components model and a time varying parameter model. Furthermore, the state space model is characterised by two important features; these are, namely, flexibility and transparency. Mergner (2009) argues that the state space model offers a high degree of flexibility and, hence, it permits time varying coefficients and missing observations. Along the same lines, Basdevant (2003) emphasises the state space model's ability to offer a simple representation of complex problems. Furthermore, it evaluates the relative features of various approaches and, therefore, it can be considered to be an encompassing approach.

State Space models have some caveats since the value of unobserved state at the beginning of time series is unknown. Specifying initial values for both parameters and hyperparametres before the estimation stage is considered to be a potential problem in the State Space model and, hence, prior information about $A_0$ is rarely available. Therefore, Basdevant (2003) argue that the Kalman filter can be initialized by using the mean and covariance matrix of unconditional distribution $A_t$ when $A_t$ is stationary or time invariant. However, if $A_t$ is non stationary or not time invariant, the conditional mean and covariance no longer exist. Unless a prior information is available, the initial distribution of $A_0$ should be determined by using diffuse prior[5] (Harvey, (1989)). Furthermore, Commandeur and Koopman (2007) suggest that researchers can depend on theoretical considerations or previous research in order to calculate a reasonable initial value.

### 2.1.3 Define PSTR model in state space form:

Although huge academic presentations exist about State Space models and the Kalman filter (e.g. Harvey, 1989; Kim and Nelson, 1999; Commandeur and Kooperman, 2007), very few economic problems have been analysed by using State Space models. Mergner (2009) relates this to the shortage of available software to estimate these models. However, we argue that State Space models can be applied easily by using available software such as Eviews.

The main contribution in this paper stems from Hall et al., (2016) who mention that nonlinear models along with a single framework can be represented within a standard time varying coefficient model. This permits both measurement errors and missing variables. Although Kalman filter and state space system should be linear in state variables, they can deal with other variables nonlinearities. Therefore, we contribute to the literature by estimating a popular threshold model within a panel framework (PSTR) in state space model format. Our main contribution is four fold.

Firstly, we define the PSTR model in state space form so that we can estimate the threshold level of government size and examine its impact on economic growth. The State Space model is defined as follows:

Measurement equation: $$y_{it} = \beta_{0t} + \beta_{1t} gfce^{6}{}_{it} + \varepsilon_{it} \quad (8)$$

Transition equation: $$\beta_{0t} = \pi_0 \quad (9)$$

---

[5] Diffuse prior means establishing a proper prior value from the first (m) sets of observations.

[6]Gfce: defined as general government final consumption expenditure as percentage of GDP.

$$\beta_{1t} = \pi_1 \mathrm{G}\ (Z_{it}, \gamma, \mathrm{C}) + \pi_2[1\text{- G}\ (Z_{it}, \gamma, \mathrm{C})] \qquad (10)$$

Where the transition function defined as:

$$\mathrm{G}\ (Z_{it}, \gamma, \mathrm{C}) = \frac{1}{(1+\exp(-\gamma(Z_{it}-c)))} \qquad \gamma > 0 \qquad (11)$$

Where, $y_{it}$ displays the annual growth rate of GDP and $\beta_{0t}$ shows fixed country effect. Both $\pi_{1t}, \pi_{2t}$ display how government size affects economic growth above and below the threshold level respectively. Whereas, G ($Z_{it}$, γ, C) represent our transitional function. Hence, $Z_{it}$ displays the threshold variable of government size, γ determines the slope or smoothness of transition between regimes while C displays the threshold value. Accordingly, this can be considered to be a special case of the former equation (4) e.g. $A_{1t} = \beta_{0t}$ , $A_{2t} = \beta_{1t}$ , $x_{1t} = \pi_0$ and $x_{2t} = \pi_1$G ($Z_{it}$, γ, C) + $\pi_2$[1- G ($Z_{it}$, γ, C)] where T=0 and $Q_t$= 0. It can be clearly seen that the time varying parameter model is non-standard, therefore least square approach cannot be implemented.

Secondly, this technique outperforms other models and, hence, it allows for the inclusion of more than one threshold variable in a single model. According to the specifications of the State Space model, it facilitates the simultaneous estimation of two or more different threshold variables. Therefore, we estimate two different threshold variables at same time by using different coefficients for each variable. Hence, we have two different transition functions; each function is defined for a certain threshold variable. While each variable has its own threshold level (C) and slope (γ) separately. Previous studies provide clear evidence about the non-linear relationship between inflation and economic growth (i.e. Omay and Kan; 2010, Lopez-Villavicencio and Mignon; 2011; Seleteng et al., 2013). Therefore, we employ inflation as another threshold variable alongside government size to be estimated simultaneously; this is relatively new in the literature. Likewise, this allows us to explore the effects of both government size and inflation beneath and beyond their threshold levels. Consequently, the state space model can be defined as:

Measurement equation:

$$y_{it} = \beta_{0t} + \beta_{1t} inf_{it} + \beta_{2t} gfce_{it} + \varepsilon_{it} \qquad (12)$$

Transition equations:

$$\beta_{0t} = \pi_0 \qquad (13)$$

$$\beta_{1t} = \pi_1 G_1\ (q_{it}, \gamma_1, C_1) + \pi_2[1\text{-}\ G_1\ (q_{it}, \gamma_1, C_1)] \qquad (14)$$

$$\mathrm{G}\ (q_{it}\ , \gamma_1, C_1) = \frac{1}{(1+\exp(-\gamma_1(q_{it}-C_1)))} \qquad \gamma > 0 \qquad (14.a)$$

$$\beta_{2t} = \pi_3 G_2\ (\mathrm{Z_{it}}, \gamma_2, C_2) + \pi_4[1\text{-}\ G_2\ (\mathrm{Z_{it}}, \gamma_2, C_2)] \qquad (15)$$

$$\mathrm{G}\ (Z_{it}, \gamma_2, C_2) = \frac{1}{(1+\exp(-\gamma_2(Z_{it}-C_2)))} \qquad \gamma > 0 \qquad (15.a)$$

In state equation (14), $q_{it}$ is defined as the threshold variable of inflation while $\gamma_1$ and $C_1$ determine the smoothness of transition between regimes and the threshold value of inflation respectively. Meanwhile, ($\pi_{1t}$ ,$\pi_{2t}$) represent how inflation affects economic growth above and below the threshold level respectively. However, in state equation (15), $Z_{it}$ represents the threshold variable of government size and, similarly, $\gamma_2$ and $C_2$ determine the smoothness of transition between regimes and the threshold value of government size respectively. However, ($\pi_{3t}$ ,$\pi_{4t}$) demonstrate the impact of government size on economic growth above and below the threshold level.

Thirdly, we developed our second contribution to impose an econometric restriction on the transitional function since we restrict the transitional variables coefficients ($\gamma_1, \gamma_2, C_1, C_2$) of the above mentioned threshold variables to be the same (C and γ). In other words, we estimate only one threshold value (c) for two different threshold variables (inflation and government size). Subsequently, the threshold value (c) is analysed as the optimal threshold level for both variables. Thus, the state space equations are defined as follows:

Measurement equation:

$$y_{it} = \beta_{0t} + \beta_{1t} inf_{it} + \beta_{2t} gfce_{it} + \varepsilon_{it} \qquad (16)$$

Transition equations:

$$\beta_{0t} = \pi_{0t} \qquad (17)$$

$$\beta_{1t} = \pi_1 G\ (q_{it}, \gamma, C) + \pi_2[1\text{- } G\ (q_{it}, \gamma, C)] \qquad (18)$$

$$G\ (q_{it}, \gamma, C) = \frac{1}{(1+\exp(-\gamma(q_{it}-c)))} \qquad \gamma > 0 \qquad (18.a)$$

$$\beta_{2t} = \pi_3 G\ (Z_{it}, \gamma, C) + \pi_4[1\text{- } G\ (Z_{it}, \gamma, C)] \qquad (19)$$

$$G\ (Z_{it}, \gamma, C) = \frac{1}{(1+\exp(-\gamma(Z_{it}-c)))} \qquad \gamma > 0 \qquad (19.a)$$

In contrast to the previous case, (c) is defined as the threshold value for both inflation and government size while ($\gamma$) represents the simultaneous smoothness of transition between regimes for both variables.

Fourthly, according to Hall et al. (2016), a stochastic STAR model can be represented by introducing a stochastic error term in equation (22). Thus, we repeat all the previous steps independently but with a stochastic transition function. The simplest way to estimate the state space model is as follows:

Measurement equation: $y_{it} = \beta_{0it} + \beta_{1t} gfce_{it} + \varepsilon_{it}$ (20)

Transition equation: $\beta_{0t} = \pi_0$ (21)

$$\beta_{1t} = \pi_1 G\ (Z_{it}, \gamma, C) + \pi_2[1\text{- } G\ (Z_{it}, \gamma, C)] + U_{it} \qquad (22)$$

$$G\ (Z_{it}, \gamma, C) = \frac{1}{(1+\exp(-\gamma(Z_{it}-c)))} \qquad \gamma > 0 \qquad (22.a)$$

As we can see, the main difference between the stochastic format and the former static format is the inclusion of an error variance expression to our state or transition equation (22). The errors in equation (22) are assumed to be distributed normally with constant variance. The error term allows capturing any adjustment or part of the adjustment that might happen from the error term itself.

## 3 Data:

This study's employed sample comprises 5 developing countries selected from the Middle East and North Africa (MENA) region: these are, namely, Egypt, Iran, Morocco, Tunisia and Turkey. We selected these countries due to the availability of the data for a long period of time. We obtained the balanced panel data from World Bank development indicators (WDI) while the time span is from 1970 to 2014.

Our dependent variable is defined as annual growth rate of GDP ($y_{it}$). We use general government final consumption expenditures percentage of GDP (gfce % GDP)[7] as a measure of government size. It is defined as government current expenditures to buy all goods and services and, moreover, it consists of most spending on defence and security and eliminates government military expenditures. Additionally, we employ inflation as a source of macroeconomic stability, it is measured by the annual growth rate of the Consumer Price Index (CPI); it is presumed that it will inhibit rates of economic growth. Previous studies confirm the existence of a non-linear relationship between inflation and economic growth. Thereby, we use it as an additional threshold variable and, hence, we introduce a new way to estimate simultaneously two different threshold variables. Moreover, in order to avoid any misspecifications, and according to (Levine and Renelt, 1992; Barro and Sala-i-Martin, 1995) we included a number of control variables, for instance: Investment defined as gross fixed capital formation as a percentage of GDP. This is expected to have a positive effect on economic growth since it represents the physical accumulation. Similarly, Trade, as a % of GDP, is supposed to enhance economic growth and the population's rate of growth.

[7] It is worth mentioning that the employed method has not been developed in the IV approach. One weakness, which applies to all threshold models, is dealing with the endogeneity problem. Kourtellos et al., (2007) argue that a solution for estimating a threshold model where both slope and threshold variable are endogenous does not exist currently. Moreover, Hausman test shows no evidence of endogeneity which might rise between government size and economic growth. In the same vein, some of previous studies average their dataset over 4 or 5 years so as to avoid the variations in annual growth rates. I am in favour to employ annual observations, thus it enables us to capture the maximum variations in the

Pulling data from the Quality of Government Institute, version Jan 2016, University of Gothenburg, we employ the Human Capital Index (HCI) based on years of schooling (Barro and LEE, 2010). Additionally, this new data set provides a more comprehensive indicator of quality of government. For robustness checks, we employ Quality of Government index (Qog) which represents a simple average of the ICRG variables (corruption, rule of law and bureaucracy quality). It is scaled from 0 to 1, the higher the score, the higher the quality of government. In this respect, the data is available only during the period from 1984 to2014. In this context, previous studies mention that quality of government represents another source of non-linearity (i.e. Christie, 2014; Pushak et al., 2007); however, they employ World Bank government effectiveness indicators (Kaufmann et al., 2009). Furthermore, we use the Executive Corruption Index (Execorr) which is considered to be a measure of executive bribery and embezzlement. Also, we use both debt as % of GDP and revenue as % of GDP as a source of fiscal sustainability. In this respect, the data for the countries being studied is available only for the period from 1990 to 2014.

## 4 <u>Empirical Results:</u>

We are interested in understanding government size behaviour and how it affects economic growth. Therefore, Table 1 reports the statistics of government size for each country. According to this Table, we can see that Egypt records the maximum level of government size (28.22164 % of GDP) while, among all the MENA countries, Turkey reported the minimum level of government size (7.515493% of GDP). We can see that, among all the countries, the average level of government size reaches (15.10147 % of GDP). Table 2 presents the correlation matrix for all variables employed in our baseline model. As expected, both inflation and government size have a negative effect on economic growth and they are not correlated with each other.

employed dataset. Furthermore, if government expenditures depend on current level of growth, it cannot be endogenous because we cannot promptly observe government size impact on economic growth.

## 4.1 State space estimation results:

Along the same line with our methodological framework, the rate of growth of GDP is defined as a function of both government size and inflation. In this case, we assume the presence of a non-linear relationship between government size and economic growth. We assert that the state space model can be considered to be the best way to capture the non-linearities between government size and economic growth.

Mittnik and Neumann (2003) confirm that, due to modifications in government size, fixed effect models cannot be employed to display the variations in the growth effect. Hence, there may exist periods of positive and negative effects which, in turn, cancel each other and may lead to rejection of the endogenous growth hypothesis. Furthermore, they suggest using state dependent or state varying coefficients to represent the relationship between government size and economic growth. This is because they believe that this approach illustrates the non-linear effects to a greater extent. Consequently, in order to address the non-linearities between government size and economic growth, we define the PSTR model in the form of state space equations.

Table 1: Summary Statistics for Government Size

| | Egypt | Iran | Morocco | Tunisia | Turkey | Full Sample |
|---|---|---|---|---|---|---|
| Mean | 15.13299 | 14.70781 | 17.71836 | 16.41565 | 11.53255 | 15.10147 |
| Median | 12.63167 | 13.18154 | 18.12708 | 16.42856 | 11.72639 | 15.16296 |
| Maximum | 28.22164 | 23.84220 | 21.67107 | 19.28257 | 15.34633 | 28.22164 |
| Minimum | 10.28571 | 9.714636 | 11.66719 | 13.22522 | 7.515493 | 7.515493 |
| Std. Dev. | 5.213710 | 4.054677 | 2.347842 | 1.138179 | 1.943883 | 3.867966 |
| Skewness | 1.117411 | 0.703515 | -1.239808 | -0.078668 | -0.267745 | 0.511023 |
| Observations | 45 | 45 | 45 | 45 | 45 | 225 |

Table 2: Correlation Matrix for 5 MENA Countries (1970-2014)

| Correlation | GDP | GFCE | INF | INV | POP | TRADE |
|---|---|---|---|---|---|---|
| GDP | 1.000000 | | | | | |
| GFCE | -0.052194 | 1.000000 | | | | |
| INF | $-0.139898^{**}$ | $-0.429855^{***}$ | 1.000000 | | | |
| INV | -0.032970 | $0.293976^{***}$ | -0.066861 | 1.000000 | | |
| POP | -0.092681 | $0.149204^{**}$ | 0.051408 | $0.245704^{***}$ | 1.000000 | |
| TRADE | 0.085625 | $0.394868^{***}$ | $-0.411095^{***}$ | $0.236825^{***}$ | $-0.360216^{***}$ | 1.000000 |

*Notes*: *, **, *** display the significance levels at 10%, 5% and 1% respectively.

#### 4.1.1 STAR model with static transition function:

Our results for the selected MENA countries are consistent with previous studies; which confirm that developing countries are looking for more government expenditures to build their infrastructures (i.e. Yavas; 1998, Bergh and Henrekson; 2011). According to Model A, first row of Table 4, we can see that government size has a detrimental effect on economic growth in both cases above $(\pi_{1t})$ and below $(\pi_{2t})$ the threshold level. However, the growth effect of government size is only statistically significant below the threshold level and loses its significant impact beyond the threshold level. Furthermore, we find that, for the MENA countries, the estimated threshold level of government size at 18.1259 % of GDP is significant at the 1% significance level. However, in this case, we note that the slope $(\gamma)$ of the transition function is very high; this shows that the impact of government size on economic growth changes quickly when government size is close to the threshold level.

With respect to the significance of the threshold variable, the formulation of PSTAR model in the state space system has an advantage over the original PSTR model. This is because the former model does not provide the statistics of the threshold variable itself. However, in this paper we follow Hansen's (1999) approach and employ the likelihood ratio statistics for the test on the threshold variable. On the other hand, Dijk et al., (2000) illustrate the difficulty in obtaining a precise estimate for the smoothness of transition among regimes (γ). Since, as shown in Table 4, the estimated speed of transition between regimes has a large value; this indicates that our transition function appears to be a step function. Furthermore, it can be seen clearly from Figure 3 that our estimated threshold variable is half way and has no immediate neighbourhood. Therefore, we argue that only a small impact on the transition function is recognized with respect to any change in the value of (γ). Consequently the estimation for (γ) might be insignificant. It is worth mentioning that this is not evidence of week nonlinearity; however, this relates to the identification problem (i.e. γ=0 cannot be tested due to the presence of unidentified nuisance parameters).

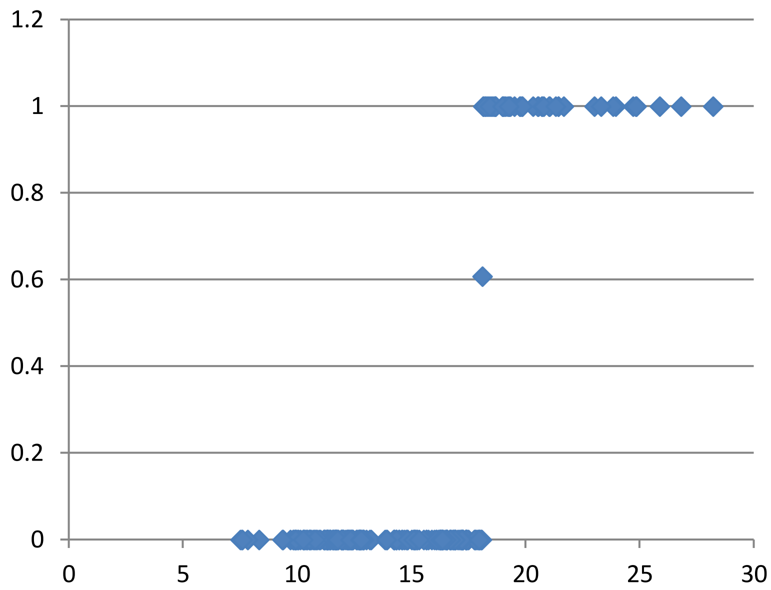


**Fig.3. The estimated transition function.**

*x− axis represent the transition variable,while y−axis display the transition function g ($q_{it}$; γ,c)

Table 4: Estimate the threshold level for both Government Size and Inflation. (Static coefficient).

| GDP growth | $\pi_1$ | $\pi_2$ | Transition Variables | |
|---|---|---|---|---|
| | | | $\exp(\gamma)$ | C |
| **Model (A)** government size (gfce) | -0.11886 (0.2555) | -0.25028 $(0.0567)^{*}$ | 5.928677 | 18.12592 $(0.0001)^{***}$ |

**Model. B)** Estimate two different threshold variables using different coefficients.

| | $\pi_3$ | $\pi_4$ | $\pi_1$ | $\pi_2$ | $\exp(\gamma_1)$ | $\exp(\gamma_2)$ | $(c_1)$ | $(c_2)$ |
|---|---|---|---|---|---|---|---|---|
| Inflation | -0.0428 $(0.063)^{*}$ | -0.2326 (0.2027) | — | — | 8.2171 | — | 5.9137 $(0.001)^{***}$ | — |
| Government size (gfce) | — | — | -0.12020 (0.3555) | -0.29823 $(0.0912)^{*}$ | — | 8.4004 | — | 19.012 $(0.001)^{***}$ |

**Model. C)** Estimate two different threshold variables using same transition coefficients.

| | $\pi_3$ | $\pi_4$ | $\pi_1$ | $\pi_2$ | $\exp(\gamma)$ | C |
|---|---|---|---|---|---|---|
| Inflation | -0.07053 $(0.0158)^{**}$ | -1.2774 (0.1512) | — | — | -1.277425 (0.1512) | 14.54799 $(0.0000)^{***}$ |
| Government size (gfce) | — | — | -0.47843 $(0.0142)^{**}$ | -1.25453 $(0.0601)^{*}$ | | |

*Notes*: Values between parentheses represent p-values. *, **, *** display the significance levels at 10%, 5% and 1% respectively. $\pi_1$ and $\pi_2$ represent the impact of government size above and below the estimated threshold level. $\pi_3$ and $\pi_4$ represent the impact of inflation above and below the estimated threshold level. The significance of the threshold calculated by the likelihood ratio test of Hansen (1999) approach.

Previous studies proved theoretically and empirically the existence of a nonlinear relationship between inflation and economic growth (i.e. there exist a threshold level of inflation beyond which it has a negative effect on economic growth), (e.g. Khan and Senhadji, 2001; Omay and Kan, 2010; Voana and Schiavo, 2007; Burdekin et al., 2004). Therefore, we contribute to the literature by estimating two different threshold variables (i.e. inflation and government size). Model B in Table 4 represents the results of estimating two different threshold variables (inflation and government size). In this case, we have two different transition functions; each function display different threshold variable. Consistent with the first row, we can note that government size has a significant and negative impact on economic growth below the threshold level ($\pi_{4t}$) while, beyond this level ($\pi_{3t}$), it tends to have an insignificant impact on economic growth. The estimated threshold level for government size is 19.012% of GDP whereas the slope of the transition function ($\gamma_2$) is still very high. In the same vein, our results reveal the presence of a threshold level of inflation above which it has a significant destructive impact on economic growth ($\pi_{1t}$) while, during a low inflation regime($\pi_{2t}$), it has an insignificant impact on growth. Furthermore, we find that the estimated threshold level of inflation ($c_1 = 5.913\%$) is similar to the case of government size, the speed of transition between regimes is considered to be very high.

Correspondingly, Model C in Table 4 displays how we estimate jointly the threshold level of both inflation and government size as we restrict the transition parameters for both variables to be same. In turn, this means that, for both variables, we have one threshold value ($c$) and one slope of transition between regimes ($\gamma$). The estimated threshold level of both inflation and government size is 14.54% and is significant at the 1% significance level. Nevertheless, under this condition, we cannot capture the non-linear impact of government size on economic growth since it has a significant and negative impact on economic growth during both regimes. A possible explanation for this finding is that, in this case, the estimated threshold level is lower than the former estimated values (i.e. 18.125%, 19.012% of GDP for both models A and B. On the other hand, the results confirm the nonlinear relationship between inflation and economic growth. Hence, we recognize that, during high inflation regimes, inflation has a significant and negative impact on economic growth; however, it loses its significant impact in low inflation regimes.

### 4.1.2 STAR model with a stochastic transition function:

Along the same lines, we develop the way of defining PSTR model in state space equations. Hence, we write the state space model in stochastic format by adding error variance expression to the state transition equation. In this case, we define the model as a STAR model with stochastic transition function. Consistent with our former results, we can confirm that, during low inflation regimes, government size has a statistically significant negative impact on economic growth. According to the first row of Table 5 (i.e. Model A.), we can see that the threshold level of government size ($c = 17.75295\%$ of GDP) is approximately the same as the level which we achieved in the non-stochastic form (Model A, Table 4). While the slope of transition between regimes is considered to be smooth, it is, indeed, much lower in this case.

Similarly, we estimate the threshold levels of both government size and inflation using different coefficients. Consistent with Model B in Table 4, we find that the estimated threshold level of both inflation and government size are 5.9135% and 19.012% of GDP respectively. With respect to Model C in Table 5, we impose an econometric restriction by setting both government size and inflation to the same coefficients. Our results confirm the presence of a nonlinear relationship between inflation, government size and economic growth. Hence, the estimated threshold level for both variables is 12.02159%; this level is considered to be lower than our baseline model. Thereby, in both cases, government expenditure hurts the rate of economic growth rate, as more expenditures are required to enhance economic growth. While the slope of transition between regimes is smooth and slower than the baseline model. Lastly, in order to show the difference between the transitions functions in both cases (i.e. static and stochastic case), both Figures 4 and 5 represent the estimated state variables for each individual country at each point of time for both case deterministic and stochastic transition function respectively. As it displays the behaviour of government expenditures during the employed period of time, hence it represents the combination of both coefficients $\pi_1$ and $\pi_2$ (i.e. above and below the threshold level), which is new in the existing literature.

Table 5: Estimate the threshold level for both Government Size and Inflation. (stochastic coefficient).

| GDP growth | $\pi_1$ | $\pi_2$ | Transition Variables | |
|---|---|---|---|---|
| | | | $\exp(\gamma)$ | C |
| **Model <u>(A)</u>** government size (gfce) | -0.11325 (0.2063) | -0.34677 (0.0330)** | 0.747548 (0.4667) | 17.75297 (0.0000)*** |

**Model. <u>B)</u>** Estimate two different threshold variables using different coefficients.

| | $\pi_3$ | $\pi_4$ | $\pi_1$ | $\pi_2$ | $\exp(\gamma_1)$ | $\exp(\gamma_2)$ | $(c_1)$ | $(c_2)$ |
|---|---|---|---|---|---|---|---|---|
| Inflation | -0.0412 (0.069)* | -0.12666 (0.2918) | — | — | 8.2171 | — | 5.9137 (0.001)*** | — |
| Government size (gfce) | — | — | -0.08406 (0.3843) | -0.26657 (0.0310)** | — | 8.4004 | — | 19.012 (0.001)*** |

**Model. <u>C)</u>** Estimate two different threshold variables using same transition coefficients.

<table>
<tr><th></th><th>$\pi_3$</th><th>$\pi_4$</th><th>$\pi_1$</th><th>$\pi_2$</th><th>$\exp(\gamma)$</th><th>C</th></tr>
<tr><td>Inflation</td><td>-0.07053 (0.0299)**</td><td>0.02929 (0.7988)</td><td>—</td><td>—</td><td rowspan="2">-1.37272 (0.0076)***</td><td rowspan="2">12.02159 (0.0000)***</td></tr>
<tr><td>Government size (gfce)</td><td>—</td><td>—</td><td>-0.55736 (0.0360)**</td><td>-2.12965 (0.0000)***</td></tr>
</table>

*Notes*: Values between parentheses represent p-values. *, **, *** display the significance levels at 10%, 5% and 1% respectively. $\pi_1$ and $\pi_2$ represent the impact of government size above and below the estimated threshold level. $\pi_3$ and $\pi_4$ represent the impact of inflation above and below the estimated threshold level. The significance of the threshold calculated by the likelihood ratio test of Hansen (1999) approach.

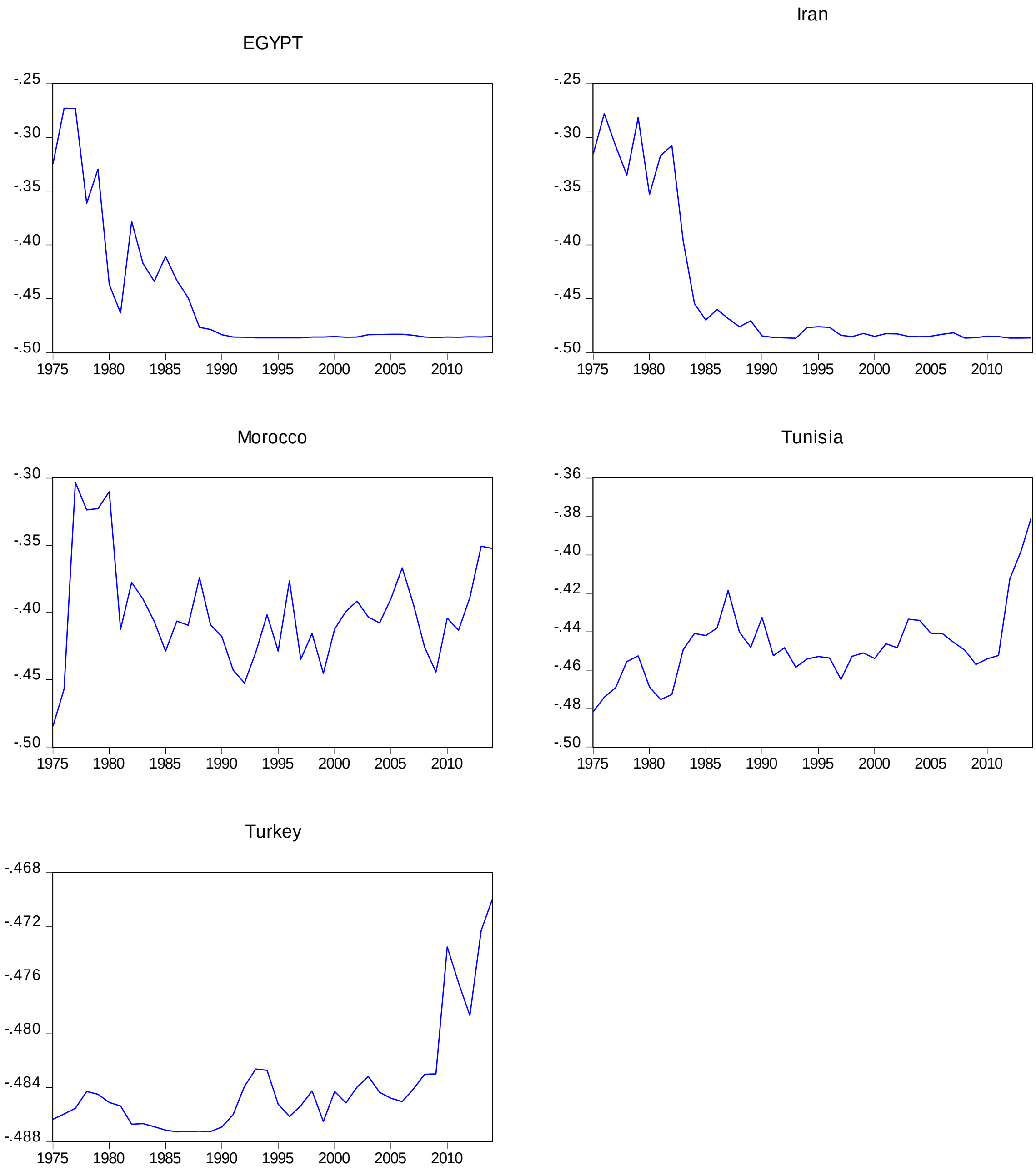


**Fig. 4 Estimated state variables at each point of time, Model (A), Table (4).**

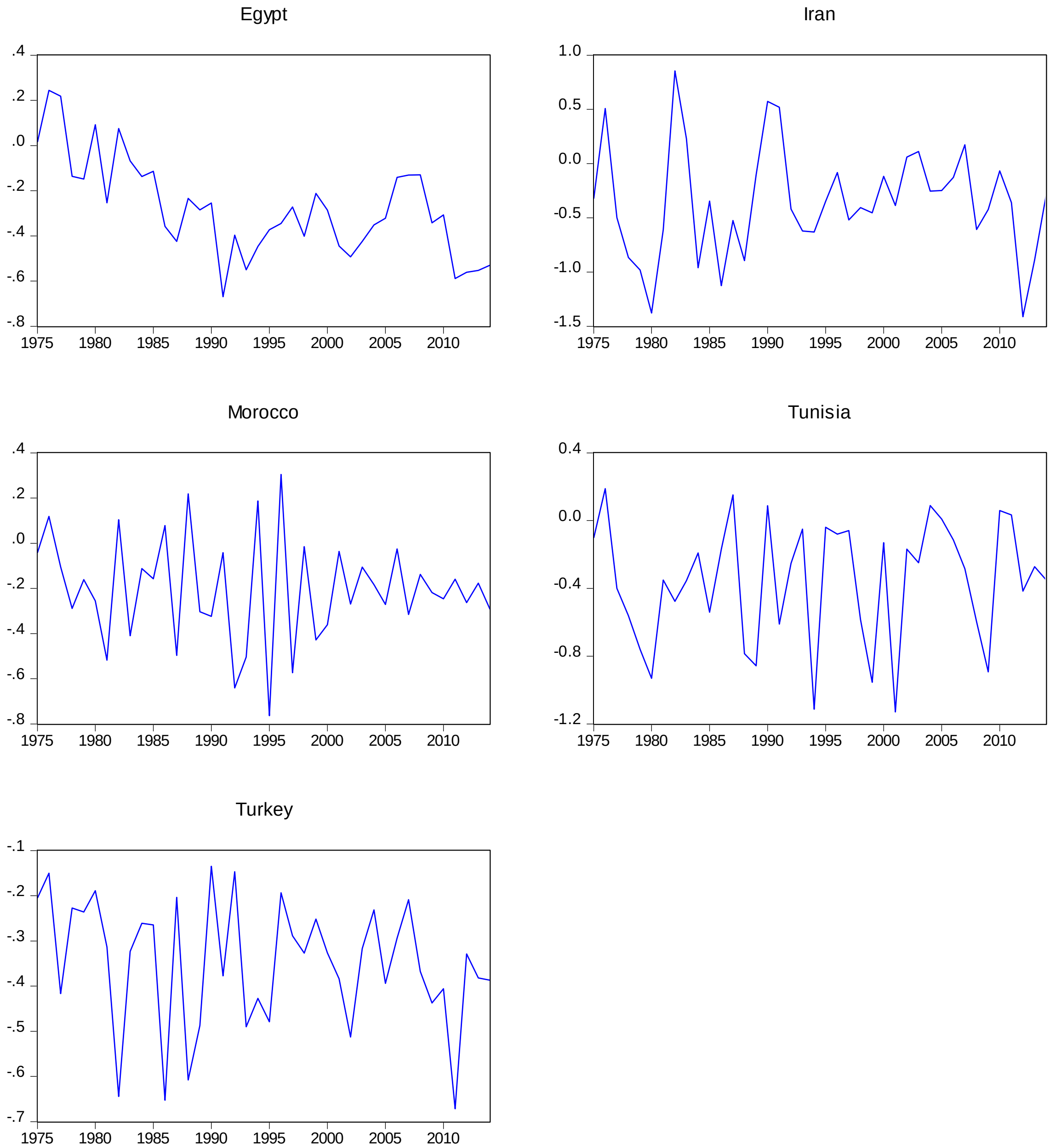


**Fig. 5 Estimated state variables at each point of time, Model (A), Table (5)**

### 4.1.3 Avoid Misspecifications and Add control variables:

In order to avoid any misspecifications that might arise from omitted variables and following previous studies, we augment our base line model with control variables. As established in the empirical literature, some variables are considered to be beneficial in growth models. Therefore, as defined in section 3.5, we control inflation, investment as % of GDP, human capital index, trade as % of GDP and population growth. The results in both Tables 6 and 7 are synchronized with the estimation of our baseline model (i.e. Tables 4 and 5). Both tables assert the existence of a non-linear relationship between government size and economic growth.

With respect to Table 6, there is a very slight change in the estimated threshold values for both government size and inflation. Since the observations lie in the high regime, any further increase in government spending leads to a decline in economic growth by 0.48%. On the other hand during low regime, government size shows a less distortionary impact on economic growth. Although the coefficient is still negative, it is considered to be small and insignificant. All our control variables have the expected signs according to the literature but only inflation in Model A and the Human Capital Index in Model B have a significant impact on economic growth. Similarly, Table 7 displays results for the STAR model with a stochastic transition function; our results are consistent with Table 5. With respect to Model A in Table 7, a higher and significant threshold level of government size was realised. While the non-linear impact is consistent with our baseline findings, we recognise, also, in all three models that investment enhances the rate of economic growth. Similarly, the estimated threshold level of inflation in both Models B and C is consistent with our earlier findings; only a very slight change in the magnitude of the coefficients was realised.

Table 6: Estimate the threshold level for both Government Size and Inflation. (Static coefficient with control variables).

| GDP growth | $\pi_1$ | $\pi_2$ | Transition Variables | |
|---|---|---|---|---|
| | | | C | Exp ($\gamma$) |
| **Model <u>(A)</u>** gfce | -0.267168 (0.1154) | -0.487458 (0.0595)$^{*}$ | | |
| Inf | -0.066458 (0.0071)$^{***}$ | | | |
| Inv | 0.15229 (0.3006) | | 19.04174 (0.0000)$^{***}$ | -0.47658 (0.7038) |
| hci | -2.83895 (0.1523) | | | |
| trade | 0.051139 (0.28939) | | | |

**Model. <u>B)</u>** Estimate two different threshold variables using different coefficients.

| | $\pi_1$ | $\pi_2$ | $\pi_3$ | $\pi_4$ | Transition Variables | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | $\exp(\gamma_1)$ | $\exp(\gamma_2)$ | $(c_1)$ | $(c_2)$ |
| Inf | -0.0668 (0.012)$^{***}$ | -0.1971 (0.266) | | | 8.217 | | 5.913 (0.05)$^{**}$ | |
| gfce | | | -0.26248 (0.1786) | -0.43120 (0.0654)$^{*}$ | | 9.152 | | 19.015 (0.05)$^{**}$ |
| Inv | 0.11442 (0.3729) | | | | | | | |
| hci | -2.92150 (0.0680)$^{*}$ | | | | | | | |
| trade | 0.04384 (0.3425) | | | | | | | |

**Model. <u>C)</u>** Estimate two different threshold variables using same transition coefficients.

| | $\pi_1$ | $\pi_2$ | $\pi_3$ | $\pi_4$ | Transition Variables | |
|---|---|---|---|---|---|---|
| | | | | | C | Exp ($\gamma$) |
| Inf | -0.07053 (0.0158)$^{**}$ | -0.057905 (0.7491) | | | | |
| gfce | | | -0.4784 (0.0142)$^{**}$ | -1.25453 (0.0601)$^{*}$ | 14.54799 (0.0000)$^{***}$ | -1.277425 (0.1512) |
| Inv | 0.125019 (0.4388) | | | | | |
| hci | -2.727506 (0.1649) | | | | | |
| trade | 0.032979 (0.5124) | | | | | |

*Notes*: Values between parentheses represent p-values. *, **, *** display the significance levels at 10%, 5% and 1% respectively. $\pi_1$ and $\pi_2$ represent the impact of government size above and below the estimated threshold level. $\pi_3$ and $\pi_4$ represent the impact of inflation above and below the estimated threshold level. The significance of the threshold calculated by the likelihood ratio test of Hansen (1999) approach.

Table 7: Estimate the threshold level for both Government Size and Inflation.
(Stochastic coefficient with control variables).

| GDP growth | $\pi_1$ | $\pi_2$ | Transition Variables C | Transition Variables Exp ($\gamma$) |
|---|---|---|---|---|
| **Model <u>(A)</u>** gfce | -0.036515 (0.7401) | -0.29396 (0.0398)$^{**}$ | | |
| Inf | -0.06904 (0.0037)$^{***}$ | | 23.5824 (0.051)$^{**}$ | 5.40776 |
| Inv | 0.22477 (0.0129)$^{**}$ | | | |
| pop | 0.0517 (0.9456) | | | |
| trade | 0.04758 (0.8453) | | | |

**Model**. **<u>B)</u>** Estimate two different threshold variables using different coefficients.

| | $\pi_1$ | $\pi_2$ | $\pi_3$ | $\pi_4$ | Transition Variables $\exp(\gamma_1)$ | $\exp(\gamma_2)$ | $(c_1)$ | $(c_2)$ |
|---|---|---|---|---|---|---|---|---|
| Inf | -0.0567 (0.079)$^{*}$ | -0.0671 (0.626) | | | 8.217 | | 5.913 (0.000)$^{***}$ | |
| gfce | | | -0.1709 (0.291) | -0.3757 (0.056)$^{*}$ | | 9.152 | | 19.015 (0.000)$^{***}$ |
| Inv | 0.185805 (0.0872)$^{*}$ | | | | | | | |
| pop | -0.32547 (0.7448) | | | | | | | |
| trade | -0.015015 (0.6280) | | | | | | | |

**Model. <u>C)</u>** Estimate two different threshold variables using same transition coefficients.

| | $\pi_1$ | $\pi_2$ | $\pi_3$ | $\pi_4$ | Transition Variables C | Transition Variables Exp ($\gamma$) |
|---|---|---|---|---|---|---|
| Inf | -0.062363 (0.0575)$^{*}$ | 0.06479 (0.6510) | | | | |
| gfce | | | -0.52764 (0.059)$^{*}$ | -2.13859 (0.0914)$^{*}$ | 12.4362 (0.0000)$^{***}$ | -1.495059 (0.0478)$^{**}$ |
| Inv | 0.197235 (0.0612)$^{*}$ | | | | | |
| pop | -0.87402 (0.4251) | | | | | |
| trade | -0.03968 (0.2259) | | | | | |

*Notes*: Values between parentheses represent p-values. *, **, *** display the significance levels at 10%, 5% and 1% respectively. $\pi_1$ and $\pi_2$ represent the impact of government size above and below the estimated threshold level. $\pi_3$ and $\pi_4$ represent the impact of inflation above and below the estimated threshold level. The significance of the threshold calculated by the likelihood ratio test of Hansen (1999) approach.

#### 4.1.4 Robustness Checks:

For sensitivity analysis, we carried out other robustness tests by using additional control variables. Table 8 displays the robustness checks results. Generally, the results are consistent with our findings in Tables 4 to 7. The estimated threshold variable and its qualitative impact are synchronized with our main results. Although, when we augment our model with additional control variables, the results change since, as a measure of fiscal sustainability, we attempted to control debt as the % of GDP. As shown in Model A Table 8, it does not support the presence of a threshold level of government expenditure. Since we cannot provide evidence of a significant threshold level, correspondingly, during both regimes, government size loses its significant impact on economic growth. Indeed, this means probably that debt may be responsible for the distortionary impact of government expenditure on economic growth. Along the same lines, taxes can be another channel through which government spending can have a negative effect on economic growth but, due to the unavailability of the data for the MENA countries being studied, we cannot detect its impact. On the other hand in Model B, we control government net revenue as % of GDP and realize a significant threshold level of government expenditure (17.6325% of GDP) below which government spending has a deleterious impact on economic growth.

In the same context, other studies are concerned about the importance of good governance that can help to mitigate the distortionary impact of government size on economic growth. They argue that government effectiveness or quality of government can be another source of nonlinearity. For instance, Christie (2014) split his sample between high and low effective governments. He observes the predominance of the nonlinear effect of government size on economic growth in a low effect government. On the other hand, in a highly effective government, there is no evidence of non-linearity. In our analysis, we employ quality of government (Qog) and executive corruption (Execorr) as indicators of government effectiveness. We classified the MENA countries as having medium class effective governments and, on average, the quality of government = 0.52465. As reported in Models C and D Table 8, our results display clear evidence of nonlinearity while the coefficients of both Qog and Execorr have a non-significant impact on economic growth.

On average we can see that the estimated threshold level of government size (18.1259%) is beyond the average level for all the MENA region countries. Nevertheless, for most of the MENA region countries, the average level of government size is very close to the estimated threshold level. Our results suggest that policy makers should expand government expenditures since we find a threshold level of government size below which it has a distortionary effect on economic growth. Also, we observe that the speed of transition between two regimes is very high.

We expect that the results, obtained in the context of our selected sample of MENA region countries, can be of relevance to other developing countries. Accordingly, these results can be used as guidelines for other countries that share similar levels of development, economic structure and cultural environments. Moreover, this study provides evidence for policy makers since it can help them to identify which countries actually can increase their government expenditures and promote economic growth over the long term. However, the optimal composition of government expenditures for each country really matters. Therefore, further research needs to be done in order to provide policy makers with clear and precise guidelines. Another suggested avenue of research is to compare the existing results with oil exporter countries within the MENA region e.g. Gulf countries which are characterised by higher levels of government expenditures.

Table 8: Estimate the threshold level for both Government Size (Additional Control variables).

| GDP growth | Model (A) | | Model (B) | | Model (C ) | | Model (D) | |
|---|---|---|---|---|---|---|---|---|
| | $\pi_1$ | $\pi_2$ | $\pi_1$ | $\pi_2$ | $\pi_1$ | $\pi_2$ | $\pi_1$ | $\pi_2$ |
| gfce | -0.35234 (0.4964) | -0.64215 (0.1675) | -0.6421 (0.167) | -0.9948 (0.0375)** | -0.2458 (0.1772) | -0.47435 (0.0724)* | -0.19933 (0.7714) | -0.86866 (0.0546)** |
| Inf | -0.077114 (0.0178)** | | -0.076402 (0.0080)*** | | -0.066920 ( 0.0074)*** | | -0.064237 (0.08610)* | |
| Inv | 0.02628 (0.8577) | | 0.276034 (0.3571) | | 0.15457 (0.3340) | | 0.245968 (0.2001) | |
| hci | -6.447072 (0.0353)** | | 1.449421 (0.4203) | | -2.95076 (0.1572) | | 1.700672 (0.4665) | |
| trade | 0.09662 (0.0154)** | | | | 0.050813 (0.3218) | | 0.016248 (0.7385) | |
| Debt %GDP | **-0.048770 (0.0073)*** ** | | | | | | | |
| Revenue % of GDP | | | **-0.073115 (0.4811)** | | | | | |
| Execorr | | | | | **1.806857 (0.6444)** | | | |
| Qog | | | | | | | **-0.010060 (0.9985)** | |
| Transition Variables: C | 17.409519 | | **17.63225 (0.0000)*** ** | | **18.91809 (0.0000)*** ** | | **17.91914 (0.0000)*** ** | |
| Exp (γ) | 103.73467 | | 0.914071 | | -0.484366 | | 0.544144 | |

*Notes*: Values between Parentheses represent P-values. *, **, *** display the significance levels at 10%, 5% and 1% respectively. $\pi_1$ and $\pi_2$ represent the impact of government size above and below the estimated threshold level.

# 5 CONCLUSION

So far, no consensus has been reached regarding the relationship between government size and economic growth. This is because some scholars argue that a large government has a dampening effect on economic growth while others confirm that the reverse is true. In this study, we reviewed theoretically and empirically all the possible effects of government size on economic growth. We provide evidence for the debate in the empirical literature regarding the government size-economic growth nexus. One of the possible explanations for these different results is the sample selection, causality problem and chosen methodological framework. In other words, some of these studies include countries with various growth patterns and ignore the variations in the levels of economic development and the different composition of government expenditures. Along the same lines, other studies examine the non-linear hypothesis using inappropriate methodological frameworks to capture the existing non-linearity between government size and economic growth. In turn, these may lead to estimation bias.

This paper analysed the non-linear relationship between government size and economic growth. We employed panel data for 5 countries within the Middle East region for the period from 1970 to 2014. The MENA region countries have been largely ignored in the context of government size and economic growth. However, it is important to study these countries since they suffer from high political instability and inefficient government expenditures. Consequently, it is important for policy makers to determine the more productive government functions. In this study, we contribute to the literature by introducing a new approach to estimating one of the threshold models, namely, the Panel Smooth Transition Regression (PSTR) approach developed by Gonzalez et al., (2005). We defined the PSTR model in the form of state space system equations.

Based on the PSTR specifications, we captured both cross-country heterogeneity and time variability in the context of government size and economic growth. Moreover, we estimated the threshold level of government size endogenously and the speed of transition between regimes. We developed the state space model to estimate two different threshold variables simultaneously (i.e. to estimate their threshold values and the speed of transition between regimes using different transition coefficients $(c_1, c_2, \gamma_1, \gamma_2)$. We improved the model further in order to restrict the transition function coefficients to be similar for both threshold variables. In other words, we had only one threshold value (c and γ) for two different threshold variables. Lastly, we developed the model further to allow for a stochastic transition function.

Generally, our findings are consistent with the recent empirical literature which confirms the non-linear hypothesis in government size and economic growth nexus (e.g. Pevcin, 2004; Davies, 2009 and Christie, 2012). Our reported results confirmed that the threshold level of government size in the selected MENA region countries was 17.245%. We recognized that government size had a significant negative impact on economic growth below the estimated threshold level while, beyond that level, it had an insignificant negative impact on economic growth. The smoothness of transition between regimes was very high; this indicated that government size changed its impact on economic growth suddenly when it was close to the estimated threshold level. With respect to estimating two various threshold variables employing different coefficients, our results provide evidence of non-linearity between government size, inflation and economic growth. We observed the estimated threshold level of inflation and government size to be ($c_1$= 5.913% and $c_2$= 19.0127%) respectively. Therefore, during a high inflation regime, inflation had a dampening effect on economic growth while, during a low inflation regime, it had an insignificant positive impact on economic growth. Our results for the government size threshold level were consistent with our baseline findings.

In order to draw a good policy recommendation, it is important to understand that each country has it is own characteristics and the composition of government expenditures varies from one country to another. Therefore, finding a threshold level of government size does not necessarily mean that expanding government expenditure leads to an increase in economic growth. However, the efficient composition of public expenditures and the presence of a threshold level should be considered. Accordingly, it might be useful for further research to study the optimal composition of public expenditure for each country in order to provide policy makers with precise guidelines.

## REFERENCES


ABU-BADER S, ABU-QARN A.S. 2003. Government expenditures, military spending and economic growth: causality evidence from Egypt, Israel, and Syria. *Journal of Policy Modeling,* **25**(6), pp. 567-583.

AFONSO A, FURCERI, D. 2010. Government size, composition, volatility and economic growth. *European Journal of Political Economy*, **26**(4), pp. 517-532.

BARRO RJ. 1990. Government spending in a simple model of endogenous growth. *Journal of Political Economy*. Vol. 98, No. 5 (Pt. 2), pp. S103-S125.

Basdevant, Olivier. (April, 2003). *On applications of state space modelling in macroeconomics. Discussion paper series, Reserve Bank of NEW ZEALAND*. DP2003/02, pp.1-57.

BERGH A, HENREKSON M. 2010. *Government size and implications for economic growth.* . WA S H I N G T O N, D. C. The AEI Press, pp. 1-57.

CAMERON DR. 1982. On the limits of the public economy. *The Annals of the American Academy of Political and Social Science*, **459**(1), pp. 46-62.

CHEN S, LEE C. 2005. Government size and economic growth in Taiwan: A threshold regression approach. *Journal of Policy Modeling,* **27**(9), pp. 1051-1066.

CHRISTIE T. 2012. THE EFFECT OF GOVERNMENT SPENDING ON ECONOMIC GROWTH: TESTING THE NON-LINEAR HYPOTHESIS. *Bulletin of Economic Research.*

COMMANDEUR JJ, KOOPMAN SJ. 2007. *An introduction to state space time series analysis*. Oxford University Press.

Cuthbertson Keith, Hall Stephen G, Taylor Mark P. 1992. State-space models and the Kalman filter. In: *Applied Econometrics techniques*. Great Britain: Philip Allan, pp. 191-223.

DAR A.A, AMIRKHALKHALI S. 2002. Government size, factor accumulation, and economic growth: evidence from OECD countries. *Journal of policy modeling,* **24**(7), pp. 679-692.

DAVIES A. 2009. Human development and the optimal size of government. *The Journal of Socio-Economics,* **38**(2), pp. 326-330.

GONZÁLEZ A, TERÄSVIRTA T, DIJK D.V, 2005. *Panel smooth transition regression models, Working Paper Series in Economics and Finance*. No. 604.

GRANGER CW, TERÄSVIRTA T, 1993. Modelling Non-Linear Economic Relationships. Oxford: Oxford University Press.

GROSSMAN PJ. 1988. Government and economic growth: A non-linear relationship. *Public Choice,* **56**(2), pp. 193-200.

HANSSON P, HENREKSON M. 1994. A new framework for testing the effect of government spending on growth and productivity. *Public Choice,* **81**(3-4), pp. 381-401.

Harvey Andrew C. 1989. state space models and the Kalman filter. In: Harvey, Andrew C. *Forecasting, Structural time series models and the Kalman Filter*. New York: Cambridge University Press. 100-166.

HERATH S. 2012. SIZE OF GOVERNMENT AND ECONOMIC GROWTH: A NONLINEAR ANALYSIS. *Economic Annals,* **57**(194),.

IM K.S, PESARAN M.H, SHIN, Y. 2003. Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), pp. 53-74.

KARRAS G. 1996. The optimal government size: further international evidence on the productivity of government services. *Economic inquiry,* **34**(2), pp. 193-203.

KELLY T. 1997. Public investment and growth: testing the non-linearity hypothesis. *International Review of Applied Economics,* **11**(2), pp. 249-262.

KIM C, NELSON C.R. 1999. State-space models with regime switching: classical and Gibbs-sampling approaches with applications. *MIT Press Books,* **1**.

KORMENDI R.C, MEGUIRE, P.G. 1985. Macroeconomic determinants of growth: cross-country evidence. *Journal of Monetary Economics,* **16**(2), pp. 141-163.

KOURTELLOS, A., TAN, C.M. and ZHANG, X., 2007. Is the relationship between aid and economic growth nonlinear? Journal of Macroeconomics, 29(3), pp. 515-540.

LANDAU D. 1983. Government Expenditure and Economic Growth: A Cross-Country Study. *Southern Economic Journal,* **49**(3).

LEVIN A, LIN C, JAMES CHU C. 2002. Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics,* **108**(1), pp. 1-24.

MERGNER S. 2009. Linear Gaussian state space models and the Kalman filter. In: MERGNER, S *Applications of state space models in finance*. Germany: Universitätsverlag Göttingen. Pp. 17-40.

MITTNIK S, NEUMANN T. 2003. Time-Series Evidence on the Nonlinearity Hypothesis for Public Spending. *Economic inquiry,* **41**(4), pp. 565-573.

PEVCIN P. 2004. Does optimal size of government spending exist? *Working paper, University of Ljubljana*.

PUSHAK T, TIONGSON E.R, VAROUDAKIS A. 2007. Public finance, governance, and growth in transition economies: Empirical evidence from 1992-2004.

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), pp. 191-203.

YAVAS A. 1998. Does too much government investment retard economic development of a country? *Journal of Economic Studies,* **25**(4), pp. 296-308.