Non-Linear Effects of Government Consumption in Tunisia: Does Fiscal Policy Changes Matter?

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Abstract: This study examines non-linear effect of fiscal policy (represented by increases in government consumption) on private consumption. Actually, it suggests that this effect depends on the nature of fiscal policy changes. Using a STR (Smooth Transition Regression) model on Tunisia data over the 1975-2010 period, this paper provides evidence that the expansionary effect of higher government consumption decreases when fiscal policy is expansive.
Keywords: Government consumption, Private consumption, Primary deficit, Smooth Transition Regression Model, Tunisia

INTRODUCTION

The impact of fiscal policy on economic growth has been the subject of a long debate. The possibility of « non-keynesian » effects of restrictive fiscal policies started with [1], who presented the « Ricardian Equivalence» theorem : A tax reduction, financed by public debt, does not affect the demand for private consumption of economic agents.

Much of the modern literature studying the expansionary effect of fiscal adjustments in the paper of [2] examined the experiences of fiscal consolidation in Danemark (1983-86) and Ireland (1987-89). The severe restrictive policies, adopted in these two countries during the concerned periods, can produce wealth effects on private consumption because of the expectations of lower future tax liabilities. This expectations view is in fact contrasted with the keynesian view according to which a fiscal consolidation will reduce the aggregate demand.

There is no much consensus on the interaction between fiscal policy and economic activity. Consequently, the existing literature considered both the theoretical and empirical support of the opposite views.

Theoretically and according to the expectations view of fiscal policy, the first transmission channel between fiscal policy and private consumption is private household wealth. [3] developed a neoclassical model in which non-linear effects of fiscal consolidation on private consumption may arise as a function of a high level of public expenditure. This relationship is introduced between the level of private consumption and the level of government spending depending on the level of government spending to GDP. At low levels of government spending, an increase in government spending reduces private consumption. However, the household consumption behavior changes around the trigger values of government spending. Furthermore, [4] and [5] showed that the effects of fiscal policy depend on level of public debt. [5] found that, at low levels of public debt, higher government spending have keynesian effects on private consumption and non-keynesian effects at high levels of public debt.

Outside of the debate over the expectations view, credibility effect on the interest rates is the second channel by which fiscal consolidation can encourage the economy. This effect is present for highly indebted countries. At high levels of public debt, investors are facing with a risk premium on the high interest rates, such as inflation and default risk. Fiscal consolidation reduces risk premium on the interest rates, which decreases interest rates and stimulates private investment and aggregate demand [2,6].

In response to the theoretical models, several empirical studies confirm that non-keynesian effects of fiscal policy depends on a number of factors such as the composition, size and persistence of the fiscal adjustments [7].

The composition of fiscal adjustments is achieved either by increasing taxes or by reducing spending. Actually, composition is considered to be an important determinant of success and the stabilization of the fiscal variables[1]. [6], [8] and [9] argued that fiscal consolidation, which is characterized by a decrease in government spending, has a higher probability of success than the one based on tax revenues increase. [10] and [11] showed that fiscal consolidation based on cuts of government spending tends to be successful than the one based on tax revenues increase. For a sample of 15 EU[2] countries and during the 1970-1999 period, [10] found that the probability of success is high when the decrease is more significant. Recently, [11] concluded that fiscal consolidation based on reduction in public expenditure is more successful in the CEE[3] countries from 1991 to 2003.

For the EU countries between 1970 and 1998, [12] concluded that fiscal consolidation that focuses on the expenditure side, is more likely to complete a sustained fall in the public debt ratio on GDP, than the one based on taxes. For the same sample and during the 1970-2002 period, [7] showed that non-keynesian effects of fiscal consolidation, based on spending cuts are followed by an improvement of economic growth. Recently, [13,14] have found that, for a panel of OECD[4] countries, fiscal adjustments based on spending cuts and no tax increases are more likely to reduce deficits and debt ratios than those based on tax increase. Furthermore, they showed that spending based fiscal adjustments have caused smaller recession than tax based fiscal ones. For a sample of 20 OECD countries from 1970 to 2009, [15] showed that fiscal adjustments based on spending cuts have beneficial macroeconomics effects than those based on tax increases.

The empirical literature analyzing the size and persistence of fiscal adjustments is very rich. [16] examined the size and persistence of fiscal policy changes on private consumption for 19 OECD countries between 1970 and 1992. They showed that contractions and expansions of fiscal policy can have non-keynesian effects if they are sufficiently large and persistent. [17] showed that sustainable and persistent fiscal contractions are seen as a signal change in the conduct of fiscal policy for 19 OECD countries for the 1960-2000 period. When fiscal contractions are large and persistent, the fiscal policy affects the private consumption of a non-keynesian way.

[18], [19] and [20] showed that the size of the discretionary fiscal impulse is the main determinant of the non-keynesian effects. From the descriptive analysis for the NMS[5] from CEE over the 1993-2002 period, [18] found that large fiscal consolidation accelerates output growth. From a logit model and during the pre-accession period[6], [19] and [20] showed that there is high probability for non-keynesian effects in Bulgaria when the changes in the cyclically adjusted expenditure are large. In addition, the authors found that stronger fiscal expansions decelerate GDP growth, and vice versa.

For the EU-15 countries over the 1970-2005 period, [21] found that the increase of social transfers has a positive effect on private consumption in the absence of fiscal consolidation. In the presence of fiscal consolidation, the effect becomes negative.

EMPIRICAL METHODOLOGY

In this present study, we examine the non-linearity of the relationship between government consumption and private consumption using a model of regime changes. Specially, we try to estimate consumption function using a smooth transition regression (STR) model[7] recently developed by [22].

Modelling consumption function

The consumption channel seems to be a good indicator to explain non-keynesian effects of fiscal policy. For this purpose, we concentrate our research precisely on this component of aggregate demand. The empirical formulation that we use is similar to the consumption function employed by [16]. We set the private consumption to be the dependent variable and we estimate the following equation :

$$\Delta C_t = \alpha_0 + \alpha_1 C_{t-1} + \alpha_2 \Delta Y_t + \alpha_3 T_{t-1} + \alpha_4 \Delta T_t + \alpha_5 G_{t-1} + \beta_0 \Delta G_t + \beta_1 \Delta G_t . G(\gamma, c, s_t) + \varepsilon_t \qquad (1)$$

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[1] A stabilization of the debt/ GDP ratio and a reduction in the public deficit

[2] European Union

[3] Central and Eastern Europe

[4] Organization of Economic Cooperation and Development

[5] New Member States

[6] Between 1998 and 2004, a few years prior to the European Union accession

[7] The advantage of this model is that it assumes that the transition from one regime to another is based on a transition variable to test the specific nonlinearity associated with changes in regimes.

The private consumption, government consumption, tax revenues and real GDP denote C, G, T and Y. $G(\gamma, c, s_t)$ represents the transition function of the STR model. In this model, the private consumption is explained by the lagged private consumption, the change in the real GDP and the fiscal policy shocks of government consumption and tax revenues.

Smooth transition regression model

With the aim of estimating the non-linear effect of government consumption in private consumption, we use the smooth transition regression (STR) model presented by [22], defined as follows:

$$y_t = \varphi' z_t + \theta' z_t \, G(\gamma, c, s_t) + u_t \tag{2}$$

$$y_t = \{\varphi + \theta \, G(\gamma, c, s_t)\}' z_t + u_t \, , \, t = 1, \ldots T$$

Where $z_t' = (w_t', x_t')'$, is a vector of explanatory variables, with $w_t' = (1, y_{t-1}, \ldots, y_{t-p})'$ and $x_t' = (1, x_{1t}, \ldots, x_{kt})'$. Furthermore, $\varphi = (\varphi_0, \varphi_1, \ldots, \varphi_m)'$ and $\theta = (\theta_0, \theta_1, \ldots, \theta_m)'$ are $((m+1) \times 1)$ parameter vectors, and $u_t \sim iid(0, \sigma^2)$ are given. Transition function $G(\gamma, c, s_t)$ is a bounded function of the continuous transition variable s_t and continuous function between 0 and 1 in the transition variable. The slope parameter, designated by γ, controls the slope. $c = (c_1, \ldots, c_k)'$ is a is a vector of location parameters, where $c_1 \leq c_2 \leq \cdots \leq c_k$. The last expression in Equation (2) indicates that the model can be interpreted as a linear model with stochastic time-varying coefficients $\varphi + \theta \, G(\gamma, c, s_t)$. The transition function can be parameterized as a general logistic function :

$$G(\gamma, c, s_t) = \left[1 + \exp\left\{-\gamma \prod_{K=1}^{K} (s_t - c_K)\right\}\right]^{-1} \tag{3}$$

Where $\gamma > 0$ is an identifying restriction. Equations (2) and (3) define together the logistic STR (LSTR) model. Following Teräsvirta [22], the most common choices of K are K = 1 and K = 2. For K = 1, the parameters $\varphi + \theta \, G(\gamma, c, s_t)$ change monotonically as a function of s_t from φ to $\varphi + \theta$. As for K = 2, they change symmetrically around the middle $(c_1 + c_2)/2$, where the logistic function reaches its minimum value. This minimum lies between 0 and $1/2$ and reaches 0 when $\gamma \rightarrow \infty$, and $c_1 \neq c_2$ for $c_1 \leq s_t \leq c_2$. It equals to the unit when $s_t \rightarrow \pm\infty$. If $c_1 = c_2$ and $\gamma < \infty$, it is equal to $1/2$. The model becomes linear when $\gamma \rightarrow 0$.

The LSTR1 model (K = 1) is capable of characterizing the asymmetric behavior. [22] defined LSTR1 model, where the transition function is assumed to be a logistic function of order 1, which takes the following form :

$$G(\gamma, c, s_t) = [1 + \exp\{-\gamma(s_t - c)\}]^{-1} \tag{4}$$

On the other hand, the LSTR2 model (K = 2) is appropriate in situations in which the local dynamic behavior of the process is similar at both low and high values of s_t and different in the middle.
An alternative to the LSTR2 model is the so-called exponential STR (ESTR) model, which has the following transition function:

$$G(\gamma, c, s_t) = 1 - \exp\{-\gamma \, (s_t - c_1)^2\} \tag{5}$$

This function is symmetric around $s_t - c_1$, and has, at low and moderate values of slope parameter γ, approximately the same shape, albeit a different minimum value (zero).

DATA AND EMPIRICAL RESULTS
Data

The data set of the model consists of annual data of Tunisia during the 1975-2010 period. To estimate the impact of government consumption on private consumption, we used private consumption (C), government consumption (G), tax revenues (T) and real GDP (Y). All these variables are in logarithms and are measured at constant prices. To identify the nature of fiscal policy (restrictive or expansive), we used the change in the primary deficit as a transition variable. The choice of this type of variable is explained by the fact that it provides information not only about the size of a fiscal shock, but also about its persistence. This transition variable is contained in the set $s_t = \{ d_t (1 - L^n)/y_t, d_{t-1}(1 - L^n)/y_{t-1} \}$, where n = 1, 2, 3 or 4. The primary deficit[8], the current GDP and the lag operator represent respectively d, y and L.

For n = 1 in the second specification of s_t, we obtain $dp_{11} = (d_{t-1} - d_{t-2})/y_{t-1}$. This indicator measures the gap between the one-period lagged primary deficit and the two-period lagged primary deficit as a percentage of the one period lagged current GDP. When this indicator is highly positive, the fiscal policy is expansionary and contributes to an

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[8] Primary deficit is the deficit excluding interest payments on the public debt.

increase in the primary deficit. However, if this indicator is highly negative, the fiscal policy is contractionary. Moreover, if this indicator is located in an intermediate zone, at low negative (positive) levels, it clearly indicates that there is a small fiscal impulse.

Testing linearitiy against STR

The linearity tests presented below follow [22]. The hypothesis of linearity is tested against an LSTR model of order K. The p-values of significance test are presented in the first column of Table 1. To determine the number of regimes K, we propose three hypotheses for which the p-values of the corresponding F-statistics are presented in the columns labeled F_4, F_3 and F_2 in the table. Following Teräsvirta [22], the three hypotheses are $H_{04}: \beta_3 = 0$, $H_{03}: \beta_2 = 0|\beta_3 = 0$ and $H_{02}: \beta_1 = 0|\beta_3 = \beta_2 = 0$ from Equation (6), an LSTR1 model would be proposed by the strongest rejection of either H_{04} or H_{02}, whereas the smallest p-value being the one for H_{03} would imply the modeling of nonlinearities via LSTR2 (or exponential STR) models.

$$Y_t = \beta_0' z_t + \sum_{j=1}^{3} \beta_j' \tilde{z}_t \, s_t^j + u_t^*, t = 1, \dots T, z_t = (1, \tilde{z}_t)' \tag{6}$$

We conducted the non-linearity tests for the model and reported the results in Table 1. This model provides a clear evidence of a STR-type non-linearities for a number of transition variables. The null hypothesis is then rejected if dp_3, dp_2, dp_{13}, dp_{11} and dp_1 are used as transition variables in the model. The test strategy described above suggests LSTR1 model for $s_t = dp_{11}$ (Table 1).

Table 1: P-values of linearity tests of the model

Transition variables	F	F4	F3	F2	Suggested model
$dp_1(t)$	0.013	0.022	0.062	0.282	LSTR1
$dp_{11}(t)$ *	0.003	0.245	0.021	0.009	LSTR1
$dp_{13}(t)$	0.035	0.493	0.014	0.148	LSTR2
$dp_{14}(t)$	0.065	0.065	0.453	0.092	Linear
$dp_2(t)$	0.040	0.764	0.004	0.372	LSTR2
$dp_3(t)$	0.007	0.199	0.001	0.851	LSTR2
$dp_4(t)$	0.308	0.683	0.067	0.599	Linear

The table shows the p-values of linearity tests for the model. LSTR1 and LSTR2 represent logistic smooth transition models respectively with K = 1 and K = 2. The suggested transition variable is shown by an asterisk.

Estimation results of the LSTR model

From Table 2, the estimation results of equation (1) show that the effect of government consumption shocks in private consumption, depend on the nature of fiscal policy changes. We consider LSTR1 model with dp_{11} as a transition variable, which is « the gap between the one-period lagged primary deficit and the two-period lagged primary deficit as a percentage of the one-period lagged current GDP», $dp_{11} = (d_{t-1} - d_{t-2})/y_{t-1}$.

Table 2: The estimation results of the LSTR1 model

Variables	Linear part	Non-linear part
Constant	0,738* (2,080)	-
ΔY	0,271*** (1,682)	-
T_{t-1}	0,071 (1,296)	-
ΔT_t	0,074 (0,894)	-
G_{t-1}	0,272*** (1,744)	-
ΔG_t	**0,693*** (3,308)	**-0,666*** (2,908)
C_{t-1}	-0,386* (2,299)	-
γ	5,246	
c_1	0,4%	
The t-statistics are shown in the parentheses. * and *** denote a significance at the 1% and 10% level, respectively.		

Following this table, the positive sign of the transition variable $dp_{11} = 0,4\%$, implies that the coefficient of the government consumption varies between small and large fiscal impulses. The first regime, $dp_{11} < 0,4\%$, is defined by a small fiscal impulse, whereas the second regime is defined by a large fiscal impulse ($dp_{11} > 0,4\%$).

In the presence of a small fiscal impulse, the impact of government consumption on private consumption is positive (the coefficient is significantly positive and equal to 0,693). Therefore, government consumption stimulates the private consumption. However, in the presence of a large fiscal impulse, the coefficient of the government consumption changes its sign and decreases (significantly negative and equal to -0,666). Hence, an increase of government consumption leads to a decline of private consumption.

Consequently, we note that government consumption moves from a standard keynesian effect below the threshold to a neoclassical effect beyond the threshold. The expansionary effect of higher government consumption decreases beyond the level of 0,4%.

Fiscal elasticity

Fiscal elasticity is defined as a weighted average of parameters β_0 and β_1. Since the transition variable is different from the government consumption, the elasticity of private consumption with respect to government consumption is equal to :

$$e^G_t = \frac{d\,C}{d\,G} = \beta_0 + \beta_1 G(s_t, \gamma, c)$$

A positive (negative) value of β_1 simply indicates an increase (decrease) of the elasticity with the value of the transition variable.

In our case, parameter β_1 is negative and equals -0,666 (Table 2). It implies that the elasticity of private consumption with respect to government consumption decreases with the value of dp_{11}. In other words, when the gap between the one-period and the two-period lagged primary deficit as the percentage of the one-period lagged current GDP increases, the elasticity of private consumption with respect to the government consumption decreases (Figure 1).
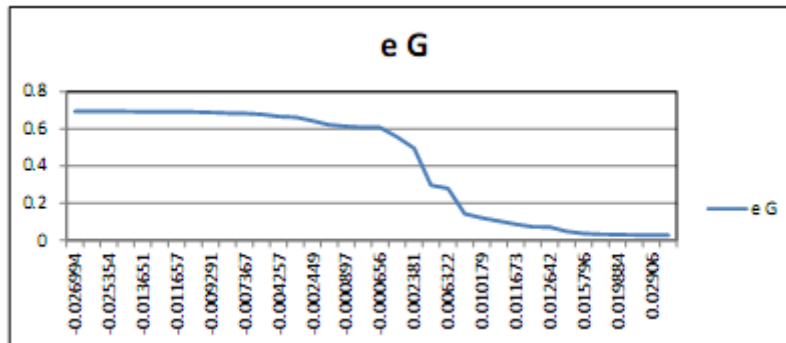

Fig-1: Elasticity of private consumption with respect to government consumption

To understand the non-linear dynamics of the estimated LSTR1 model, we provide a graphical representation of the logistic transition function. This transition function, which is plotted against transition variable dp_{11}, is shown in figure (2). It is clear that the transition function is monotonically increasing function of the value of dp_{11}. The LSTR1 specification describes well a situation of asymmetry where private consumption behavior is characterized by different dynamics. The transition function of the model between the two identified regimes is smooth.
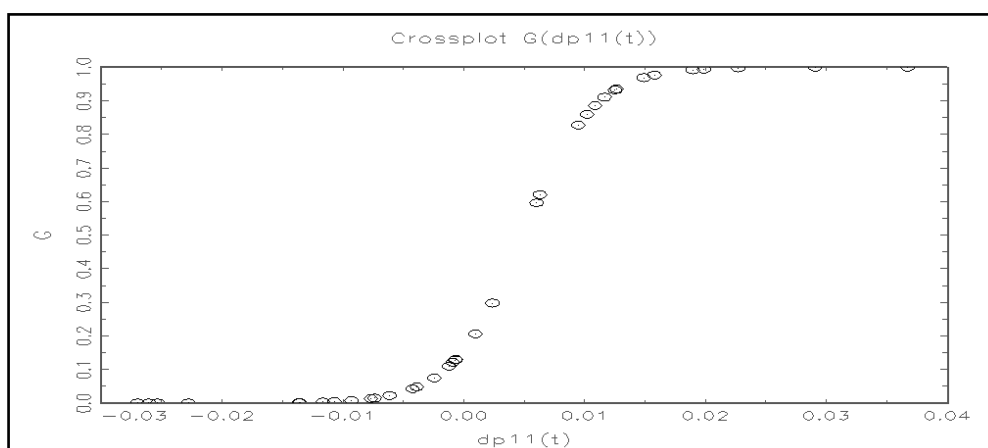
Fig-2: Transition function where dp_{11} is the transition variable

CONCLUSION

In this paper, we analyses the impact of government consumption on private consumption. Over the 1975-2010 period, we deduced a clear evidence of non-linear relationship between government consumption and private consumption in Tunisia

The application of the smooth transition regression model shows that the changes of the primary deficit determine the effect of government consumption innovations on private consumption. The results of our estimation show that if the changes in the primary deficit are beyond the level of 0,4%, the standard keynesian effect of government consumption moves to a neoclassical effect. The large fiscal impulses are very important to identify the anti-keynesian effect of fiscal policy on private consumption.

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