A crucial assumption for the solution of the endogenous growth model with government intervention is a balanced budget along the perpetual steady state. This assumption is unreal once we are interested to test the model using government data, given that in most countries the budget is not balanced. In this letter we adopt the well-known rule of ‘tax smoothing’ in order to make this assumption a realistic one. According to our approach the relevant variable for the implementation of a balanced budget is permanent government expenses. The empirical performance of the model is characterized using Israeli data.

I. INTRODUCTION

Government intervention in an endogenous growth model is usually characterized by productive expenditure financed through distortionary taxes (see e.g. Barro (1990) and Alesina and Rodrik (1992)) A crucial assumption for the solution of the model is a balanced budget along the perpetual steady state. This assumption is unreal once we are interested to test the model using government data, given that in most countries the budget is not balanced. Thus both in time series and cross section analyses, the choice of taxes or expenses as the relevant variable for the regressions becomes crucial in assessing the empirical results of the model. In this letter we propose a different approach for the balanced budget, based in the well known principle of ‘tax smoothing’. According to this approach the relevant variable for the implementation of a balanced budget is permanent government expenses.

\[ G_t = \bar{G} + \epsilon_t \int_0^\infty e^{-\delta t} dt = 0 \]  

where \( G \) is the permanent part of government expenditure and \( \epsilon \) is a transitory component (with mean zero). Furthermore, we assume that \( \bar{G} \) represents productive expenditure,\(^1\) while \( \epsilon \) represents transitory unproductive expenditure.\(^2\) According to this assumption, the production function per worker is:

\[ y_t = A_k^\alpha k_t^{1-\alpha} \]  

where \( k \) is private sector capital stock. Let us assume the following functions for taxes (\( T \)) and excess burden taxation (\( Z \)):

\[ T_t = \tau Y_t \]  

\[ Z(\tau) = \int_0^\infty f(\tau)e^{-\tau t}dt, \tau > 0, \tau'' > 0 \]  

where \( \tau \) is the income tax rate. The budget constraint of the government is:

\(^1\)Most empirical studies (Barro, 1990, Devarajan et al. 1994, Easterly and Rebelo, 1994) differentiate between productive expenditures and unproductive expenditures. The generalization of our model to this case is immediate (see Section III).

\(^2\)Barro (1981) assumes that all government expenditures are permanent, except defence expenditures. One may assume that \( \epsilon \) represents transitory defence expenditures which do not enhance production. A positive \( \epsilon \) is necessary in order to maintain country’s security in times of war threats, while a negative \( \epsilon \) (i.e. a negative deviation from permanent defence expenditures) occurs in times of peace.
The solution of the model for a balanced growth path allows us to estimate the following equation:

\[
\int_0^\infty T_t e^{-rt} dt = \int_0^\infty G_t e^{-rt} dt \quad (5)
\]

It can be shown that the optimal solution that satisfies the first order condition and the budget constraint of government in the steady state is:

\[
\tau = \frac{\sigma}{\gamma} \quad (6)
\]

i.e. the optimal taxation programme is to set \( \tau \) constant. This is a well known result in government finance, known as ‘tax smoothing’ (Barro, 1979). Taxes finance the permanent part of government expenses, while the transitory component \( \epsilon \) determines the trajectory of government debt. Given the assumption of a zero mean, the solvency condition (i.e. that government repays its debts) is fulfilled The implication of this result is that the assumption of balanced budget holds for permanent government expenditure, instead of the actual ones – as in the standard endogenous growth model.

### III. EMPIRICAL IMPLEMENTATION USING ISRAELI DATA

Assume that the utility function is:

\[
U = \int_0^\infty \frac{c_t^{1-\sigma}}{1-\sigma} e^{-\mu t} dt \quad (7)
\]

The solution of the model for a balanced growth path allows us to estimate the following equation:

\[
\ln y = C + \ln R + \ln \left(1 - \frac{g}{y}\right) \quad (8)
\]

where \( y \) represents output growth, \( C \) is a constant,\(^3\) \( R \) represents the marginal productivity of private capital,\(^4\) and \( g/y \) represents the share of permanent government expenditure in the output. This equation fits also the more general case of productive and unproductive expenditure; assuming that the transitory component is given only by defence expenditure, we can replace \( g/y \) Equation 8 by \( \tau_1 + \tau_2 \) which represent the sum of the shares in output of productive and unproductive permanent expenditure respectively.\(^5\)

We adopt different approaches in order to estimate the permanent component of \( g \). First we emphasise that as in the USA and UK (see Barro, 1987), the transitory component of expenditure in Israel is mainly explained by defence. There was a clear upward trend in the share of defence expenditure on GNP until 1978, and from then onwards there was a sharp fall. The share of all other expenditure remained after 1978 approximately fixed (a moderate downward trend was mainly explained by the decrease of interest payments, due to the decrease in debt – which is clearly a consequence of the reduction of the share of defence). Our first approximation (Equation 1 in Table 1), thus, is to estimate permanent\(^6\) defence expenses and add it to other expenses (which are considered permanent). The second approximation (Equation 2 in Table 1) is to smooth total government expenditure out of unilateral transformation transfers to public sector (mainly US aid). These transfers are high in the Israeli context (close to 7% of GNP in 1993), and one may assume that expenditure out of transfers are the permanent expenditure that the government has to finance.\(^7\)

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\(^3\) \( C \) equals \( \rho + 1/\sigma \).

\(^4\) It is easy to show that \( R \) equals \( A(1 - \rho) \sigma e^{\alpha(1-\alpha)} \). In the empirical part, we have chosen the average gross rate of return on capital as an indicator of \( R \). For more details see Dahan and Strawczynski (1994).

\(^5\) \( \tau_1 \) equals \( P/Y \) and \( \tau_2 \) equals \( U/Y \), where \( P \) represents productive expenditures and \( U \) represents unproductive expenditures, which constitute an argument in the utility function (see Barro, 1990).

\(^6\) For this purpose we used a single exponential smoothing technique.

\(^7\) Formally, we shall add unilateral transfers to the left-hand side of Equation 5.
Table 1 shows the results of the regression for the different alternatives (including dummy variables for 1967 and 1973 – war years). In the case of total expenditure we compare the performance of permanent expenditure to the one of total taxes. Concerning expenditure composition we compare the performance of smoothed defence expenditure to the one of actual defence expenditure.

The regressions based on the permanent component of government expenses (1 and 2 in the case of total expenditure, and 4 in the case of expenditure composition) have a better explanatory power than the ones based on traditional variables (regressions 3 and 5). In the case of total expenditure we may look at regression 2 as representative of the main result, since the transitory expenses component (which is equal to the difference between total and permanent expenditure) follows the traditional pattern for this kind of model – high temporary expenses in war times (mainly in the 1970s) and negative ones in the period of reduction of war threats (the 1980s). Note that this regression shows an elasticity of growth to taxes (permanent expenses) which is close to one, with a $t$ coefficient that is significant at 0.5%.

IV. SUMMARY AND CONCLUSIONS

Using the tax smoothing hypothesis allows us to implement an endogenous growth model based on a balanced budget between taxes and the permanent component of government expenditure. An empirical implementation using Israeli data shows that the model has a better explanatory power than the one based on traditional variables, for the period 1961–92. An interesting expansion of the model could be to apply this approach in a cross-section sample, as usually performed in the empirical literature of endogenous growth.

REFERENCES


