

FISCAL POLICY AND THE OPTIMAL GDP UNDER A BUDGET CONSTRAIN CONDITION

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Abstract:

In the current economic environment caused by the crisis, government loans have reached very high levels and have put pressure on the economic growth of all states. Under these circumstances governments are obliged to use a fiscal policy that takes into account the existence of a strong budget constraint and the perspective of a sustainable economic growth, which should further allow the repayment of government debt. Thus, this study analyzes the existing situation in the United States. This paper aims to identify the level of U.S. GDP, which should be achieved in the conditions of a budget constraint, determined by a sovereign debt that has exceeded in 2011 the value of \$15,000 billion.

Key words: Fiscal Policy, Budget Constrain, Optimal GDP, government borrowings

JEL classification: G01, H63, E27

I. INTRODUCTION

In the current context of economic recovery attempt from the crisis, most countries, regardless of the economic policies adopted, face the problem of increasing public debt, so the emphasis is on debt sustainability. Thus in the absence of fiscal and budget strategy linked with market needs one can enter a vicious circle of public debt.

Decision analysis of new public borrowing must target two time horizons:

- In the short term, the objective of these new loans inquired by the state must refer to the prevention of a deeper economic collapse, which would have disastrous effects;
- For the medium and long term, a recovery plan has to be implemented, accompanied by a fiscal and budget strategy in order to ensure optimal growth which will further allow repayment of the loans acquired in times of severe crises, but also will create the appropriate premises for the future sustainable economic development. Thus, an optimal rate of economic growth should be obtained, superior to the real rate of interest on state loans.

Therefore, it is very important to quantify the ability of an optimal level of GDP to cope with accumulated public debt, and identify how fiscal policy should act in order to achieve this goal. The fiscal policy of a state is viewed through the perspective of the taxpayers in terms of tax burden, the number of taxes owed, causing an aversion in their eyes. However, from the perspective of state, tax revenues are an important factor of the budgetary constraint equation.

The budget constrain equation puts in balance the annual financial effort that the state must support, reflected in government spending and the public debt service expenses, with the respective sources of funding. These sources of funding raise problems because they are limited as possibilities and many times as volume also.

State spending can be financed from fees collected. The best sources are in the form of new loans acquired to do nothing but to put pressure on future budget and future economic growth, from a monetary perspective which will generate inflationary cycles that will also affect the future economic development.

In conclusion, the only viable funding source is in the form of taxes, so the role of fiscal policy of a state is decisive in the future economic recovery.

In support of this idea, **Stanley Fischer and William Easterly** stated that: “it is increasingly recognized that sustained economic growth is possible only within a sound macroeconomic framework and that in such a framework fiscal policy plays a key role [5]”.

Gareth Myles proclaims the idea that “taxation can influence what choices are made and also the rate of growth through its effect on the return to investment or the expected profitability of research and development [10].”

However, a major interest in analyzing the influence of fiscal policy on growth is not only the tax burden, but especially the structure of tax rates.

And the impact of fiscal policy on GDP is reflected by market, namely by the way people and economic agents react to different tax rates, but is also reflected by government spending. An increase in tax rates should be reflected in an increase in public spending for investment, in order not to affect the sustainability of economic growth.

Fiscal policy should directly contribute to ensure a sustainable economic growth that will further ensure sustainability of public debt (see figure 1). **Angelo Baglioni** and **Umberto Cherubini** analyzed the sustainability of public debt of Italy, in the '80s, using the theory of intertemporal budget constraint, and concluded that fiscal policy has not been following a sustainable path in the 1980s [2].



Figure 1: The relationship between fiscal policy – economic growth – the sustainability of public debt

Optimum relationship between fiscal policy and public debt sustainability was studied by **Gottfried Haber** on the Austrian economy, trying “to assess optimal fiscal policies for debt stabilization for the historical period 1978–2000 while trying to maintain reasonable growth rates of approximately 2 percent of real GDP”[6]. **John H. Cochrane** also analyzed long-term debt and optimal policy in the fiscal theory [3]. **L. Marattin and M. Marzo** were interested in finding a fiscal rule to reduce the public debt in Italy, without affecting the stability of prices, having the starting point, the intertemporal budget constraint equation [9]. **B. Fincke and A. Greiner** have analyzed “whether selected countries of the euro area have followed sustainable debt policies over the last 30 years by analyzing the reaction of the primary surplus to GDP ratio to variations in the debt to GDP ratio. Their results suggest that three different groups can be distinguished. Firstly, the Netherlands have undergone substantial economic reforms in the 1980s that also stabilized public debt. The Netherlands was the only country where the debt ratio had declined and is clearly following a sustainable debt policy. The second group of countries consists of Germany and Portugal. Although these countries have experienced rising debt ratios over the considered period, both types of tests suggest that these governments have followed sustainable policies. Finally, the third group formed by Austria, France and Italy seem to pursue sustainable debt policies, also. But for at least one of the two tests the statistical significance of the estimation

results is smaller than for the countries of the second group [4]”. A similar analysis was undertaken by *António Afonso and João Tovar Jalles* in 2012 which showed that the fiscal rules matter for growth. They concluded that “fiscal rules foster growth, while stricter fiscal rules also mitigate the adverse impact on growth stemming from big governments, a result robust to government size proxies. Another result points to the fact that more recent EU member states, have gained more from the implementation of fiscal rules. In addition, the positive effect of fiscal rules is higher for countries with average debt-to-GDP ratios below 60%. Their results imply that having in place a set of fiscal rules, either spending or debt based, this contributes to economic growth, the existence of such rules is also bound to help reducing fiscal imbalances, a paramount issue in a context of scarce public resources and financing [1]”.

Based on these challenges, this paper aims to identify the optimal level of U.S. GDP, which should be achieved when there is a budget constraint determined by a sovereign debt that, in 2011, exceeded the value of \$15,222 billion.

II. DATA AND METHODOLOGY

Government borrowings at a time t is $B(t)$, whereas government expenditure is $G(t)$ and taxes are $T(t)$. Hence the government budget constraint can be written as:

$$dB(t) = r(t)B(t) + G(t) - T(t) \quad [7]$$

that is, new borrowings equal total government expenditure. This equation is analyzed through the transition from the two-dimensional intertemporal plan to a three-dimensional plan, leading to a substitution of the temporal variable t with the real variable Y_t (Gross Domestic Product). In these conditions, the budget constraint equation has an endogenous variable the real variable at a time t :

$$dB(Y_t) = r(Y_t)B(Y_t) + G(Y_t) - T(Y_t)$$

Integrating this equation implies that:

$$B(Y_t) = - \int_{Y_t}^{Y_n} \left\{ [G(Y_q) - T(Y_q)] e^{-\int_{Y_t}^{Y_q} r(Y_z) dY_z} \right\} dY_q$$

This is the transposition of the intertemporal budget constraint of variable Y at a certain moment in time t , implying that the debt ultimately grows at a rate that is lower than the rate of interest.

Table 1: United States situation of the budget constraint between 1973-2011

Country Situation	Nominal Growth of the Public Debt	Interest Rate	Interest Rate-growth differential
	(A)	(B)	(B) – (A)
United States	9.54	6.93	-2.61

(Source: Own Computation)

In the following section, this model, will be analyzed. In order to examine this model, the regression model will be used, based on empirical data provided by the Federal Reserve Economic Data FRED®. For this analysis, annual data from 1973-2011 was used, and the processing of the information was achieved using the Eviews software.

Identifying the Model's Equations and Verifying the Equations' Validity

In the following section the interest rate equation is presented, based on the theoretical equation:

$$r(Y) = r_0 + r_y Y$$

where $r(Y)$ – interest rate, r_0 – autonomous interest rate, r_y – interest rate sensitivity to GDP change, Y – gross domestic product (GDP).

After applying the linear regression model of the historical data, the following investment equation is obtained:

$$r(Y) = -0.524847*Y + 10.76207$$

Table 2: The Interest Rate Regression Equation

Dependent Variable: R
Method: Least Squares
Sample: 1973 2011
Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y	-0.524847	0.062462	-8.402706	0.0000
r_0	10.76207	0.528900	20.34801	0.0000
R-squared	0.656151	Mean dependent var	6.933590	
Adjusted R-squared	0.646858	S.D. dependent var	2.822611	
S.E. of regression	1.677358	Akaike info criterion	3.922237	
Sum squared resid	104.1006	Schwarz criterion	4.007548	
Log likelihood	-74.48362	Hannan-Quinn criter.	3.952846	
F-statistic	70.60547	Durbin-Watson stat	0.623371	
Prob(F-statistic)	0.000000			

(Source: Own Computation)

After analyzing the equation obtained, the following conclusions arise:

- $F_{calc} > F_{tab}$ indicates that the model is statistically significant (valid);
- Prob (F-statistic) = 0.00 indicates that the model is valid for a probability of 100%.

Considering the R-squared of 0.6561 and the Adjusted R-squared of 0.6468, these aspects lead to the conclusion that there is a strong intensity of the relationship between the endogenous variable and exogenous variable.

After testing the model's parameters, through t-Statistic, the following conclusions are obtained:

- The r_0 parameter has a t-Statistic of 20.34 and a Prob. of $0.0000 < 0.05$, indicating that the parameter is significant;
- The r_y parameter has a t-Statistic of -8.40 and a Prob. of $0.0000 < 0.05$, indicating that the parameter is significant.

In the following section the budgetary deficit equation is presented, based on the theoretical equation:

$$BD[r(Y)] = bd_r * r(Y)$$

where $BD(r)$ – budget deficit, r_y – budget deficit sensitivity to interest rate change, r – interest rate.

After applying the linear regression model of the historical data, the following investment equation is obtained:

$$BD[r(Y)] = 0.020934 * r(Y)$$

Table 3: The Budget Deficit Regression Equation

Dependent Variable: BD
 Method: Least Squares
 Sample: 1973 2011
 Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R	0.020934	0.008422	2.485608	0.0174
R-squared	-0.233941	Mean dependent var		0.230230
Adjusted R-squared	-0.233941	S.D. dependent var		0.353815
S.E. of regression	0.393029	Akaike info criterion		0.995437
Sum squared resid	5.869913	Schwarz criterion		1.038093
Log likelihood	-18.41103	Hannan-Quinn criter.		1.010742
Durbin-Watson stat	0.214749			

(Source: Own Computation)

After testing the model’s parameters, through t-Statistic, the following conclusions are obtained: the bd_r parameter has a t-Statistic of 2.4856 and a Prob. of $0.0174 < 0.05$, indicating that the parameter is significant, and the model is valid.

Achieving The Budget Constraint Model

Further, using the equations obtained above and the calculation assumptions, the empirical model of the budget constraint of the U.S. economy. After obtaining the model, the optimal level of GDP will be identified which the government policies should consider a main objective, so that the high level of the U.S. public debt no longer restricts the economic development. Therefore, the initial equation is:

$$B(Y_t) = - \int_{Y_t}^{Y_n} \left\{ [G(Y_q) - T(Y_q)] e^{-\int_{Y_t}^{Y_q} r(Y_z) dY_z} \right\} dY_q$$

In this equation, we introduce the empirical expression for $r(Y_z)$, and the difference between $G(Y) - T(Y)$ is the budget deficit (BD), which is also introduced in the model.

$$B(Y_t) = - \int_{Y_t}^{Y_n} \{ [BD[r(Y_q)] e^{-\int_{Y_t}^{Y_q} r(Y_z) dY_z}] \} dY_q$$

Further, the first defined integral is solved, considering the fact that Y_t is GDP in the year 2011, worth 15.32080 trillions of dollars. Also, BD is replaced by the function obtained after solving the regression model.

$$B(Y_t) = - \int_{Y_t}^{Y_n} \left\{ 0.020933 * [-0.262424 * Y_q + 10.752070] * e^{-[(-0.262424 * Y_q^2 + 10.762070 * Y_q) - 103.283487]} \right\} dY_q$$

After the model is simplified based on a single variable, the resulting expression is integrated as follows:

$$B(Y_t) = 0.020934 * \int_{Y_t}^{Y_n} \left\{ -[-0.262424 * Y_q + 10.752070] * e^{-[(-0.262424 * Y_q^2 + 10.762070 * Y_q) - 103.283487]} \right\} dY_q$$

In order to achieve the model, the following relationships between variables and calculation assumptions are considered:

$$\begin{aligned} -r(Y) = f'(Y) &= -(-0.524847 * Y_q + 10.752070) \\ f(Y_q) &= -[-0.262424 * Y_q^2 + 10.762070 * Y_q - 103.283487] \\ B(Y_t) &= 0.020934 * \int_{Y_t}^{Y_n} \left\{ f'(Y_q) * e^{f(Y_q)} \right\} dY_q \end{aligned}$$

After integration, the budget constraint model is obtained, using the function with variable Y (gross domestic product):

$$B(Y_t) = 0.020934 * e^{0.262424 * Y_n^2 - 10.762070 * Y_n + 103.283487} - 0.020934$$

III. RESULTS AND CONCLUSIONS

After obtaining the budgetary constraint model, the optimum level of GDP can be determined, namely the level that can support the U.S. public debt. Thus, in 2011, we have $Y_{2011} = \$15.32080$ trillion, $B(Y_{2011}) = \$15.22294$ trillion.

In these conditions, $B(Y_t)$ is substituted by $B(Y_{2011}) = \$15.22294$ trillion; the equation is solved in order to obtain the optimum level of GDP.

Resulting,

$$0.020934 * e^{0.262424 * Y_n^2 - 10.762070 * Y_n + 103.283487} - 0.020934 = 15.22294$$

$$0.262424 * Y_n^2 - 10.762070 * Y_n + 103.283487 = \ln \frac{15.22294 + 0.020934}{0.020934}$$

After performing the calculations, the following form of the equation is obtained, and the solution leads to the optimal level Y_n for the optimal GDP.

$$0.262424 * Y_n^2 - 10.762070 * Y_n + 96.692929 = 0$$

After solving the equation, these solutions were obtained: $Y_n = \$13.2941$ trillion and $Y_n = \$27.7162$ trillion. From these two values the higher value is further considered, denoting the optimal level of GDP under current budgetary constraint, determined by a public debt of \$15.222 trillion.

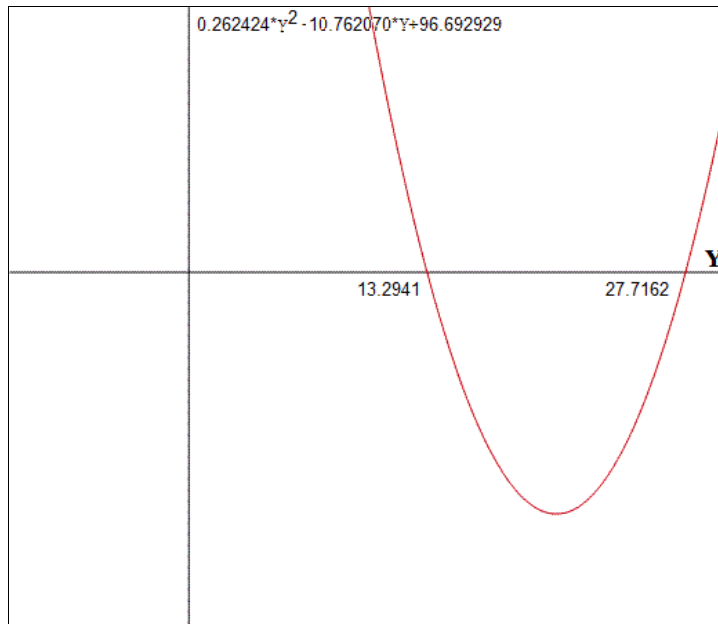


Figure 2: Optimal GDP under a budget constrain condition

In these conditions, using the model presented above, the optimal GDP for the current level of public debt of the United States is estimated at a value 27.716 trillions of dollars, while the actual value of GDP is approximately \$15.320 billion. Thus, the GDP should grow by 80.91% in order to achieve the optimal value which could lead to a sustainable economic growth, without the pressure of a public debt of approximately \$15,222 billion at the end of 2011.

After solving the model, public debt should reach an optimal weight in GDP of about 54.92%, giving a U.S. economic growth of 80.91%.

Given the findings of this study, the fiscal policy should be used as a tool for achieving this objective. Furthermore, the fiscal policy can determine the increase of the national income from $Y_1 = \$ 15.320$ trillion to $Y_2 = \$ 27.716$ trillion.

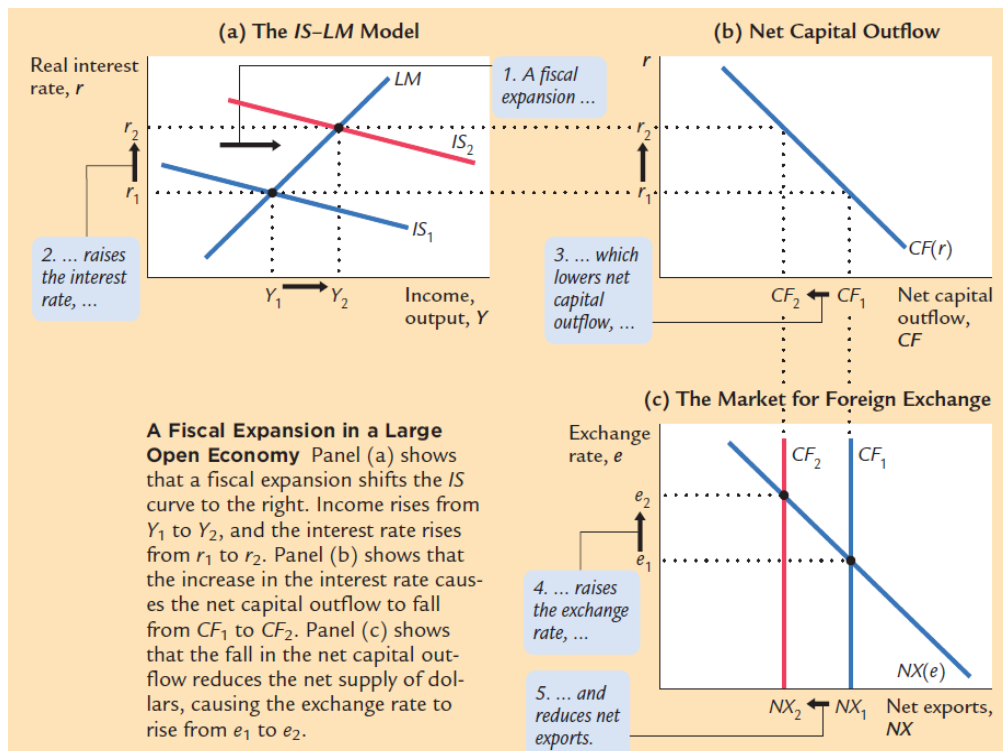


Figure 3: Fiscal Policy and the GDP growth on the IS-LM Model (Source: Mankiw, 2009)

Figure 3 shows that a fiscal expansion does raise income in the large open economy. In the U.S. economy, namely a large open economy, there is yet another offsetting factor: as the interest rate rises, the net capital outflow falls, the currency appreciates in the foreign-exchange market, and net exports fall. Together these effects are not large enough to make fiscal policy powerless, as it is in a small open economy, but they do reduce the impact of fiscal policy.

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