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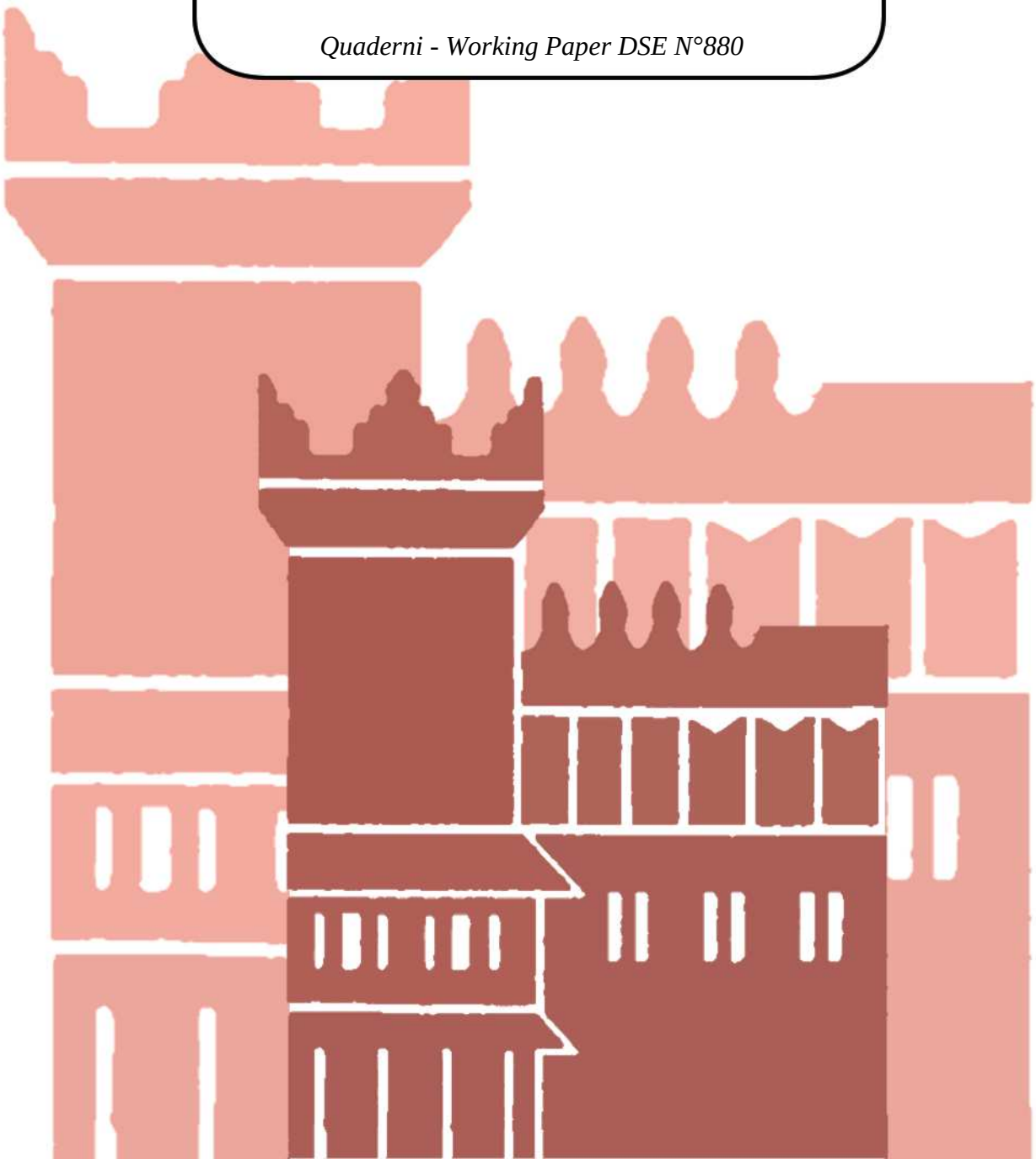

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Abstract

This paper offers a formal analysis of the relationship between changes in government primary balance and debt-to-GDP ratio. it establishes the conditions under which a fiscal consolidation increases - instead of decreasing - the stock of government liabilities relative to aggregate output. A crucial role is played by the relationship between the elasticities of average cost of debt and nominal output to primary balance: while the former depends on debt maturity and risk premia dynamics, the latter relates to the well-known controversy on the size of government spending multipliers. The paper shows an application to the ongoing fiscal consolidation process in the Eurozone.

JEL Classification: E62, H62

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1 Introduction

As most economies have been implementing severe fiscal consolidation processes, the debate is open on the effectiveness of what has been called "economic austerity" (Gros 2011,Blanchard and Leigh 2013, Mauro et al 2013). If the reduction of debt-to-GDP ratios is believed to be the most appropriate measure of the effectiveness of fiscal consolidations processes, it is necessary to acknowledge the presence of several ways in which changes in the fiscal position can actually achieve the objective, at least in the short-run.

This short note outlines a simple theoretical framework in which such a transmission mechanism can be properly analyzed. Using the arithmetic of government budget constraint, this note identifies and discusses the conditions under which a change in primary balance causes a change of the same sign in the debt-to-GDP ratio. We employ this condition as a measure of the effectiveness of austerity.

Our starting point is that there are three forces acting on the transmission chain from primary budget changes to debt-to-GDP dynamics. One is direct: *ceteris paribus*, an increase/decrease in the government net absoption of resources causes an increase/decrease of the stock of nominal debt. The other two are indirect, and work in opposite ways: an increase (decrease) in primary deficit increases (decreases) nominal growth in the short-run and therefore reduces (increases) debt-to-GDP ratio. At the same time, by modifying risk premia on the existing and new debt, increases (decreases) the average cost of debt and therefore increases (decreases) debt-to-GDP . We consider the government primary balance as the primitive fiscal policy instrument, disregarding here the disaggregation between revenue and expenditure components of the budget.

Our results show that a given primary budget reduction is successful in causing an actual decrease of debt-to-GDP ratio only if elasticities of debt's average cost and nominal output with respect to primary deficit satisfy certain conditions. The natural heterogeneity of those conditions across different economies (according to the composition of the total budget) can have a coordinated fiscal policy move result in opposite effects, even with similar values for elasticities.

The rest of the paper is organized as follows. Section 2 outlines the setting and identifies the conditions, providing also a graphical representation and an application to Euro-area economies. Section 3 discusses analytically the results and section 4 offers some concluding remarks.

2 Conditions for effectiveness of austerity

This section identifies and discusses the conditions connecting changes in the policy instrument to their effects on the debt-to-GDP ratio. We also present an application to major EMU economies.

The starting point is the simple nominal government flow budget constraint:

$$B_t = \vartheta_t(D_t^{pr})B_{t-1} + D_t^{pr} \tag{1}$$

where B_t is the end-of-the-period stock of government nominal liabilities, ϑ_t is the average cost of debt (obtained by dividing interest payments by total stock of gross government liabilities) and D_t^{pr} is the primary budget deficit[1]. We assume that ϑ_t is a function of D_t^{pr} , as changes in primary budget affect risk premia on new debt and therefore its average cost, even though the last step crucially depends on debt's maturity structure.

In order to express (1) in terms of debt-to-GDP dynamics, we divide it by nominal GDP (Y_t):

$$\frac{B_t}{Y_t} = \vartheta_t(D_t^{pr})\frac{B_{t-1}}{Y_t\left(D_t^{pr}\right)} + \frac{D_t^{pr}}{Y_t\left(D_t^{pr}\right)} \tag{2}$$

The above expression is the familiar law of motion of the stock of government liabilities relative to aggregate output (Marattin and Marzo 2010). Assuming the policy instrument to be the primary deficit $D_t^{pr}(>0)$, we analyze how $\frac{B_t}{Y_t}$ is affected by policy changes. Equation (2) explicitly takes into account that changes in primary deficit contemporaneously affect the level of income. Partial derivative of (2) with respect to D_t^{pr} reads:

$$\frac{\partial\left(\frac{B_t}{Y_t}\right)}{\partial D_t^{pr}} = \frac{B_{t-1}}{Y_t}\left[\frac{\partial\vartheta_t}{\partial D_t^{pr}} - \frac{\vartheta_t}{D_t^{pr}}\varepsilon_t^{DY}\right] - \frac{1}{Y_t}\left[\varepsilon_t^{DY} - 1\right]$$

with ε_t^{DY} being the elasticity of nominal output with respect to primary balance: $\varepsilon^{DY}\left(=\frac{D_t^{pr}}{Y_t}\frac{\partial Y_t}{\partial D_t^{pr}}\right)$. Note that $\varepsilon_t^{DY} > 0$ in the short run, because under nominal rigidities output is demand-determined. We cannot make unambiguous statements on ε^{DY} in the long run, for two fundamental reasons. First, we do not have any a-priori on the cyclical position of the economy; a deficit-financed push in aggregate demand might have long-term effect if used to close output gap. Second, as mentioned in the Introduction, we disregard the distinction between expenditure and revenue components of the primary deficit; while the former - assuming non-productive public spending - has no real effects in the long run, the latter might do.

It is crucial to remind that ε_t^{DY} does not coincide with the standard definition of the fiscal policy multiplier, which normally measures the output level effect resulting from level changes in fiscal variables[2] $\left(\frac{\partial Y_t}{\partial D_t^{pr}}\right)$. Empirical estimations of $\frac{\partial Y_t}{\partial D_t^{pr}}$ oscillates around unity[3] for government spending multipliers and

[1] For the moment we assume a primary deficit, so that it enters equation (1) with a positive sign. It would be more correct to reason in terms of primary budget position, implying the use of absolute value (displaying a deficit or a surplus according to, respectively, the positive or negative values of D^{pr}). We specify that later on.

[2] Or, equivalently, the percentage change in GDP following a one per cent increase in the output share of the fiscal variable.

[3] In recent literature we can find estimations around one (Barro and Redlick 2010, Guajardo

vary considerably when it comes to tax multiplier[4]. Moreover, recent research (Auerbach and Gorodnichenko 2012, Corsetti et al 2010, Batini et al 2010) has emphasized that fiscal policy multipliers vary according to the cyclical position of the economy. The elasticity ε_t^{DY} - being based on percentage change as some of the empirical studies - is even more dependant on the state of the economy, as it is the product of the multiplier and the primary balance-to-GDP ratio. As the latter is often very modest, it is very unlikely that, regardless the multiplier's size, the elasticity is greater than one.

After a simple manipulation equation (2) becomes:

$$\frac{\partial\left(\frac{B_t}{Y_t}\right)}{\partial D_t^{pr}} = \frac{\vartheta_t B_{t-1}}{D_t^{pr} Y_t}\left(\varepsilon^{D\vartheta} - \varepsilon_t^{DY}\right) - \frac{1}{Y_t}\left[\varepsilon_t^{DY} - 1\right] \tag{3}$$

where we denote by $\varepsilon^{D\vartheta}$ $\left(= \frac{D_t^{pr}}{\vartheta_t}\frac{\partial \vartheta_t}{\partial D_t^{pr}}\right)$ the elasticity of the average cost of debt to primary budget position. Regarding the sign of $\varepsilon^{D\vartheta}$, no unambiguous theoretical a priori can be made. However many empirical contributions (Bernoth et al 2004, Ardagna et al 2007, Laubach 2009) point out a positive relationship between deterioration of budget position and the average cost of debt, through the increase in risk premia occurring as a result of the increase in credit risk.

Let's now study the sign, assuming that the budget displays a primary deficit $(D_t^{pr} > 0)$.

If (3) is positive, it means that a deficit reduction succeeds in causing a reduction in debt-to-GDP ratio. We call this scenario "pro-austerity", in order to indicate that a given decrease in primary budget is effective in reducing the stock of government liabilities as a ratio to nominal income.

If, on the other hand, (3) is negative, then a deficit reduction increases the debt-to-GDP ratio and the budget consolidation results to be ineffective. We label this scenario "anti-austerity".

$$pro-austerity \quad : \quad \frac{\partial\left(\frac{B_t}{Y_t}\right)}{\partial D_t^{pr}} > 0 \tag{4}$$

$$anti-austerity \quad : \quad \frac{\partial\left(\frac{B_t}{Y_t}\right)}{\partial D_t^{pr}} < 0 \tag{5}$$

Obviously when (3) is equal to zero, then changes in primary deficit do not affect debt-to-GDP ratio. In that case the three effects recalled in the introduction offset each other.

et al 2010, Ramey 2011 and Hall 2009) and some above one (Blanchard and Perotti 2002, Monacelli et al 2010, Blinder and Zandi 2010, Acconcia et al 2011, Fragetta and Melina 2011).

[4] Romer and Romer 2010, using the so-called "narrative approach", find it to be larger than three.

Looking at expression (3) it is easy to spot the sufficient condition for the prevailence of the pro or anti austerity regime. A budget consolidation is certainly successful if $\mid \varepsilon_t^{DY} \mid < \min\left\{\mid \varepsilon_t^{D\vartheta} \mid, 1\right\}$, whereas the "anti-austerity" regime dominates if $\mid \varepsilon_t^{DY} \mid > \max\left\{\mid \varepsilon_t^{D\vartheta} \mid, 1\right\}$. Given that, as noted above, it is quite unlikely that those elasticities are greater than one, those conditions basically tell us that a primary budget consolidation is certainly effective if the elasticity of nominal output to primary deficit is lower that the elasticity of the average cost of debt. Otherwise, the output loss associated to a budget consolidation is too large to allow for an actual reduction of the debt-to-GDP ratio.

In order to compute the necessary and sufficient conditions for the prevailence of the pro/anti austerity regime it is necessary to study the sign of (3):

$$\frac{\partial\left(\frac{B_t}{Y_t}\right)}{\partial D_t^{pr}} > 0 \Rightarrow \frac{\vartheta_t B_{t-1}}{Y_t D_t^{pr}}\left(\varepsilon_t^{D\vartheta} - \varepsilon_t^{DY}\right) - \frac{1}{Y_t}\left[\varepsilon_t^{DY} - 1\right] > 0$$

which means:

$$B_{t-1}\frac{\vartheta_t}{D_t^{pr}}\left(\varepsilon_t^{D\vartheta} - \varepsilon_t^{DY}\right) > \left[\varepsilon_t^{DY} - 1\right]$$

Multiplying both sides by D_t^{pr} it becomes:

$$B_{t-1}\vartheta_t\varepsilon_t^{D\vartheta} > \varepsilon_t^{DY}\left(D_t^{pr} + B_{t-1}\vartheta_t\right) - D_t^{pr}$$

$$\varepsilon^{D\vartheta} > \left(\frac{D_t^{pr}}{B_{t-1}\vartheta_t} + 1\right)\varepsilon_t^{DY} - \frac{D_t^{pr}}{B_{t-1}\vartheta_t} \tag{6}$$

Note that the term $\frac{D_t^{pr}}{B_{t-1}\vartheta_t} + 1$ is the inverse of the share of total primary deficit devoted to interest payments on past debt.

To account for the possibility that the primary budget position displays a surplus $S_t^{pr}(= -D_t^{pr})$ rather than a deficit, the above conditions can be expressed in absolute values. We therefore state that a given change in primary budget is successful in creating the expected change in debt-to-GDP ratio if:

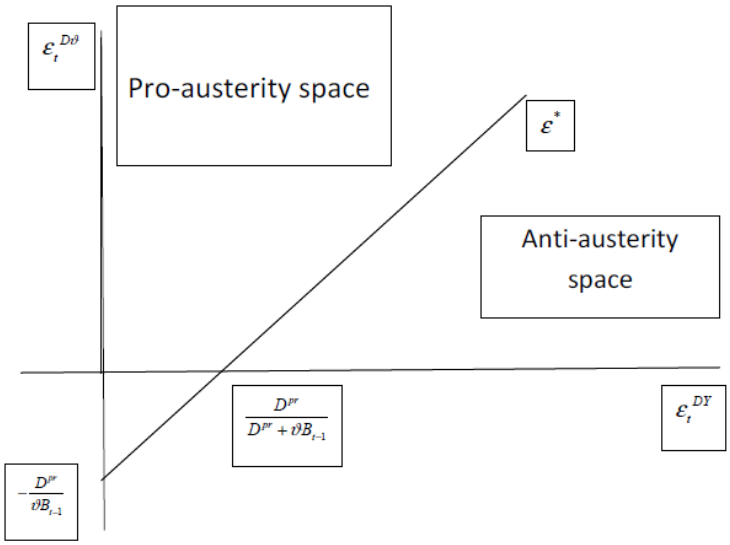
$$\mid \varepsilon_t^{D\vartheta} \mid > \frac{D_t}{B_{t-1}\vartheta_t} \mid \varepsilon_t^{DY} \mid - \frac{D_t^{pr}}{B_{t-1}\vartheta_t} \tag{7}$$

and it produces the opposite effect if, instead:

$$\mid \varepsilon_t^{D\vartheta} \mid < \frac{D_t}{B_{t-1}\vartheta_t} \mid \varepsilon_t^{DY} \mid - \frac{D_t^{pr}}{B_{t-1}\vartheta_t} \tag{8}$$

In other words, the effectiveness of a fiscal policy aimed at reducing the stock of government liabilities relative to nominal income depends on the position of $\varepsilon^{D\vartheta}$ with respect to a thresold $\varepsilon^* = \frac{D_t^{pr} + B_{t-1}\vartheta_t}{B_{t-1}\vartheta_t}\varepsilon_t^{DY} - \frac{D_t^{pr}}{B_{t-1}\vartheta_t}$

Such a threshold can be drawn in a space $\varepsilon_t^{D\vartheta} - \varepsilon_t^{DY}$ (Figure 1):

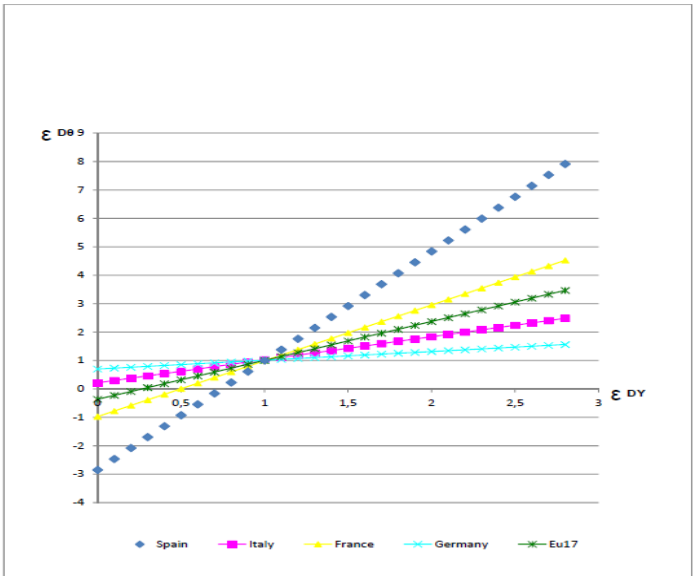


A given combination of the two elasticities allows an actual debt-to-GDP reduction after a primary budget consolidation only if it falls in the "pro-austerity" space. The threshold line ε^* represents the locus of elasticities ε_t^{DY} and $\varepsilon_t^{D\vartheta}$ that leave $\frac{B}{Y}$ unchanged. The slope of ε^* is given by $\frac{D^{pr}}{\vartheta B_{t-1}} + 1$, from which we can see that the line is downward sloping if the government accumulates a primary surplus larger than interest payments (that is, if there is a budget surplus).

Furthermore, Figure 1 clearly shows that even if the values of ε_t^{DY} and $\varepsilon_t^{D\vartheta}$ are the same across two (or more) economies, the effect of a one per cent change in primary budget can produce opposite effects in terms of the debt-to-GDP ratio dynamics.

Figure 2 replicates Figure 1 with data (year 2011) on the four major EMU economies and the overall Eurozone:

We can observe that in 2011 Spain had the smallest "pro-austerity" space, whereas Germany had the widest. Hence a coordinated fiscal policy move (even in presence of similar values of elasticities ε_t^{DY} and $\varepsilon_t^{D\vartheta}$) can have opposite effects on their respective debt-to-GDP ratios if we are anywhere in the space between the two lines.



3 What can change the pro-austerity space?

Figure 2 clearly shows that the threshold line ε^* can considerably differ across similar countries, according to their budget position. This section analyzes the framework outlined in section 2, focusing on how different structure of budget deficits at any point in time can increase or decrease the likelihood of a budget consolidation plan's success.

The partial derivative of the threshold ε^* with respect to interest payments reads:

$$\frac{\partial \varepsilon^*}{\partial \vartheta_t B_{t-1}} = \frac{D^{pr}}{\vartheta_t B_{t-1}}(1 - \varepsilon_t^{DY}) \tag{9}$$

which shows us that countries with higher interest payments on the existing stock of debt see their pro-austerity space decrease for any $\varepsilon_t^{DY} < 1$ and increase for any $\varepsilon_t^{DY} > 1$.

In other words, if a country has an higher interest rate payment, a given reduction in primary budget deficit has a lower (higher) chance to succeed if nominal output elasticity to primary deficit is smaller (greater) than one.

What is the intuition of that result?

In order to understand it, let us recall the fundamental equation (2), written in a way that can best emphasize the three transmission channel from D_t^{pr} to $\frac{B_t}{Y_t}$:

$$\frac{B_t}{Y_t} = \vartheta_t(D_t^{pr})B_{t-1} * \frac{1}{Y_t\,(D_t^{pr})} + \frac{D_t^{pr}}{Y_t\,(D_t^{pr})} \tag{10}$$

and the derivative with respect to primary deficit is given by:

$$\frac{\partial\left(\frac{B_t}{Y_t}\right)}{\partial D_t^{pr}} = \frac{\vartheta_t B_{t-1}}{D_t^{pr} Y_t}(\varepsilon_t^{D\vartheta} - \varepsilon_t^{DY}) + \frac{\left(1-\varepsilon_t^{DY}\right)}{Y_t} \tag{11}$$

where we have a "direct" effect $\left[\frac{\left(1-\varepsilon_t^{DY}\right)}{Y_t}\right]$ indicating the movement of the primary deficit-to-GDP ratio, and an "indirect" effect $\left[\frac{\vartheta_t B_{t-1}}{D_t^{pr} Y_t}(\varepsilon_t^{D\vartheta} - \varepsilon_t^{DY})\right]$ indicating the joint effect of primary budget changes on current nominal income and the average cost of debt.

If $\varepsilon_t^{DY} = 1$ a 1% reduction in D_t^{pr} is completely offset by a corresponding 1% contraction in nominal output Y, so that the "direct" effect is zero. The only effects at work are the two operating on the first and second member on the right-hand-side of (10), summarized by the "indirect" effect in (11). Therefore it is clear that an actual reduction of $\frac{B_t}{Y_t}$ can occur only if $\vartheta_t(D_t^{pr})$ diminishes more than proportionally (that is, if $\varepsilon_t^{D\vartheta} > 1$). For $\varepsilon_t^{D\vartheta} = 1$ a given reduction in D_t^{pr} does not have any effect on the debt-to-GDP ratio. In fact, the point $\left(\varepsilon_t^{DY}; \varepsilon_t^{D\vartheta}\right) = (1;1)$ belongs to the locus of elasticities which leave $\frac{B_t}{Y_t}$ unchanged after movements in D_t^{pr}. It is also clear than such a point is the one around which the locus twists anytime we have a change in the fiscal variables.

It is therefore interesting to investigate what happens to the left and to the right of $\left(\varepsilon_t^{DY}; \varepsilon_t^{D\vartheta}\right) = (1;1)$.

If $\varepsilon_t^{DY} < 1$ the direct channel is positive, as the primary deficit-to-GDP ratio diminishes after a reduction in D_t^{pr}, therefore $\frac{B_t}{Y_t}$ tends to rise. At the same time the indirect effect is negative (so a reduction in primary deficit increases debt) as for any $\varepsilon_t^{DY} < 1$ it is also true that on the threshold line $\varepsilon_t^{DY} > \varepsilon_t^{D\vartheta}$ since its slope $\left(\frac{D_t^{pr}}{\vartheta_t B_{t-1}} + 1\right)$ is by construction greater than one (which in turn is the slope of the locus of points $\varepsilon_t^{DY} = \varepsilon_t^{D\vartheta}$). The magnitude of this latter effect (pushing towards an increase - rather than decrease - of debt-to-GDP ratio) is bigger the higher the share of deficit devoted to interest payments $(\vartheta_t B_{t-1})$. Therefore an higher $\vartheta_t B_{t-1}$ shrinks the area where austerity is effective.

The opposite happens when $\varepsilon_t^{DY} > 1$. In this case the direct effect is negative, as the nominal income falls more than primary deficit. As a result primary-deficit-to-GDP ratio increases, and debt-to-GDP ratio tends to increase. The indirect effect, however, is positive, since on the threshold line $\varepsilon_t^{DY} < \varepsilon_t^{D\vartheta}$ in the region where $\varepsilon_t^{DY} > 1$. Therefore the indirect effect pushes towards a reduction of $\frac{B_t}{Y_t}$ and its size is bigger the higher $\vartheta_t B_{t-1}$. Hence, for any $\varepsilon_t^{DY} > 1$ an higher share of interest payments increases the likelihood of a successful austerity plan.

As mentioned in Section 2 when we introduced ε_t^{DY}, the empirical plausibility of $\varepsilon_t^{DY} > 1$ is however very limited.

4 Conclusions

The main dimension on which the success of austerity measures can be evaluated is their ability to reduce debt-to-GDP ratio. This paper offers a very simple theoretical framework to analyze how and when fiscal policy decisions can be successful in that sense.

The main result is that the effectiveness of budget consolidation plans depends crucially on how much percentage change in primary budget result in percentage changes in the average cost of debt and in nominal output. The first elasticity depends on a predetermined variable (the maturity structure of the existing stock of debt) and on the impact of deficit changes on the cost of new debt issuing. The second elasticity is even more significant, as it involves (but does not coincide with) the fiscal policy multiplier. This latter elasticity is very much dependant on the cyclical position of the economy and on the primary budget-to-GDP ratio (in turn depending on the state of the cycle). Hence the success of a given budget consolidation can considerably vary according to a much wider set of variables than it seems to be understood nowadays.

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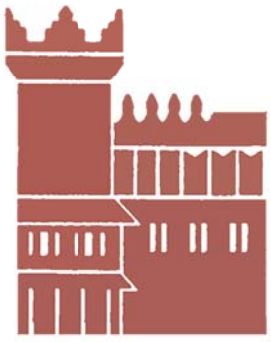

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