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Abstract

This paper shows that adopting a golden rule does not guarantee that public investment will improve economic outcomes. Our results suggest that only when the rate of return on public capital is greater than the cost of public borrowing, expanding public investment is beneficial. Otherwise, both macroeconomic stability and debt sustainability are compromised. As such, we argue that policy-makers should prioritise the productivity of public investment rather than its level.

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Key words: Public investment; public debt; golden rule.

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1 Introduction

The optimal choice of fiscal institutions has been a major issue in policy debates over the last decade. This was mainly due to sharp rises in deficit and debt levels in both industrial and developing countries during the 1980s and 1990s. The appropriate form of fiscal policy design gained even more importance in Europe due to the formation of the Monetary Union for which fiscal discipline was viewed as a pre-requisite. To ensure fiscal discipline the Stability and Growth Pact (SGP) set out a number of fiscal rules to be adhered to by member countries.

One major criticism of the SGP has been related to its implications for public investment. It has been argued that the debt and the deficit rules of the SGP seriously restrict policy-makers' willingness and ability to commit public investment in member countries.[1] Central to these arguments has been the notion that public capital spending is intrinsically different from other types of public spending; it has the capacity to enhance the future output potential of an economy. An alternative fiscal rule that has been at the centre of the policy debate is the 'golden rule' of public finances followed by the UK. One crucial difference between the UK's golden rule and the SGP is in the allowance for public investment in the former as it excludes public capital expenditures from deficit targets. In contrast, the rules of the SGP treat cafital and current expenditure the same. This aspect of the SGP has been viewed as a major drawback especially given that public investment as a share of output has been falling in EMU countries since the 1970s and was almost half of that in the US at the end of 1990s (see, for example, Creel, 2003 and Blanchard and Giavazzi, 2004).[2] As a result, a number of proposals have been put forward in favour of adopting a golden rule in eurozone instead of the framework specified by the SGP (see, for example, Fitoussi and Creel, 2002 and Blanchard and Giavazzi, 2004).[3]

This paper shows that adopting a golden rule is no guarantee that public investment is beneficial for economic outcomes. Our results indicate that public investment improves macroeconomic performance only when the rate of return on public capital projects exceeds the cost of public borrowing. We, therefore, argue that policy-makers should focus on the quality and the productivity of public investment rather than on its level.

2 The basic model

Consider the following two-period macroeconomic policy-making model that features explicit interactions between a fiscal authority (the government) and a monetary authority (the central bank).[4] The government acting through the fiscal authority controls the instruments of fiscal policy; taxes and public spending while the monetary instrument,

[1] Pereé and Välilä (2005) present an empirical investigation of the link between fiscal rules and public investment in Europe.

[2] Potential consequences of subjecting public investment to the same fiscal constraints as current spending has also been recognized by the IMF. By acknowledging the public capital spending's contribution to a country's future public revenues and growth potential, the IMF has proposed new initiatives to promote public investment in countries under IMF-supported programs (see, Hemming and Ter-minassian, 2004).

[3] An evaluation of various forms of golden rules for EMU can be found in Balassone and Franco (2000).

[4] Different variants of this model are used, for example, by Beetsma and Bovenberg (1999) and Ozkan (2000).

inflation, is controlled by an independent central bank. To explore the implications of the policy-maker's strategic decision regarding the composition of public expenditure, we distinguish between two broad spending categories; investment (g^i) and consumption (g^c). Public investment spending consists of spending, for example, on infrastructure, health and education that has a positive impact on overall productivity. In addition to these favourable consequences in future periods, public investment spending also yields contemporaneous utility to the policy-maker. Current utility also derives from current or consumption spending which consists of public wages, current public spending on goods, and other government spending which may yield immediate benefits. Taken together, these suggest that the preferences of the fiscal authority can be described by the following loss function:

$$L_t^G = \frac{1}{2} \sum_{t=1}^{T=2} \beta_G^{t-1} [\delta_1 \pi_t^2 + (x_t - \overline{x}_t)^2 + \delta_2 (g_t^c - \overline{g}_t^c)^2 + \delta_3 (g_t^i - \overline{g}_t^i)^2] \tag{1}$$

where L_t^G denotes the welfare losses incurred by the government, π_t is inflation rate, x_t and $\overline{x}_t$ are the (log of) actual and desired level of output, $g_t^c(g_t^i)$ and $\overline{g}_t^c(\overline{g}_t^i)$ are the actual and desired public consumption (investment) spending as shares of output, δ_1, δ_2 and δ_3 represent, respectively, the government's aversion for the deviations of inflation, public consumption and investment spending from their respective targets with respect to the deviations of output from its target and β_G is the government's discount factor. Target inflation rate is taken to be zero to indicate the desirability of price stability.

Likewise, the preferences of the central bank can be described as follows:

$$L_t^{CB} = \frac{1}{2} \sum_{t=1}^{T=2} \beta_{CB}^{t-1} [\mu_1 \pi_t^2 + (x_t - \overline{x}_t)^2] \tag{2}$$

where L_t^{CB} denotes the welfare losses incurred by the central bank, μ_1 is the central bank's inflation stability weight, β_{CB} is the central bank's discount factor. The independent central bank is more conservative than the elected government; $\mu_1 > \delta_1$ and it does not discount the future at as a high rate as the elected government; $\beta_{CB} > \beta_G$. Also note that no terms relating to g^c and g^i enter the central bank's loss function since public spending impacts upon the welfare of the elected government but not that of the central bank.

Now consider a representative competitive firm facing the following production function: $Y_t = A_t N_t^\gamma$, where Y_t represents output, N_t represents labour, A_t represents the level of productivity in period t and $0 < \gamma < 1$. The firm's profits is given by $P_t(1 - \tau_t) A_t N_t^\gamma - W_t N_t$, where P_t is the price level, W_t is the wage rate and τ_t is the tax rate on the total revenue of the firm in period t. The representative firm chooses labour to maximize profits by taking P_t,W_t and τ_t as given. The resulting output supply function is $y_t = \alpha(p_t + \frac{1}{\gamma}a_t - w_t - \tau_t) + z$, where lower case letters represent logs, e.g. $y_t = ln(Y_t)$, $\alpha = \gamma/(1-\gamma)$, $\ln(1-\tau) \simeq -\tau$ and $z = \alpha ln(\gamma)$.

Our formulation of the productivity effect of public investment is based on Ismihan and Ozkan (2004) and is as follows: $a_t = a_0 + \zeta g^i_{t-1}$, where $\zeta > 0$.[5] Substituting a_t into the previous equation, then normalizing output by subtracting the constant term, $z + \alpha a_0/\gamma$, for simplicity and utilizing $w_t = p^e_t$, where superscript e denotes expectation, yields the following normalized output supply function:

$$x_t = \alpha(\pi_t + \psi g^i_{t-1} - \pi^e_t - \tau_t) \tag{3}$$

In equation (3) x is the normalized (log) output, π^e is expected inflation, ψ $(= \zeta/\gamma)$ is a measure of the productivity of public investment and other variables are as defined earlier. Equation (3) suggests that a rise in public investment in $t = 1$ raises output by ψ in $t = 2$ through improved productivity.

The government budget constraint creates the link between the fiscal and monetary policies, which is formally given by:

$$g^c_t + g^i_t + (1 + r_{t-1})d_{t-1} = k\pi_t + \tau_t + d_t \tag{4}$$

where d_{t-1} denotes the amount of single-period indexed public debt issued (as a ratio of output) in period $t-1$ and to be re-paid in period t, r_{t-1} represents the rate at which it is borrowed, d_t is the new debt issue in period t, and k is the real holdings of base money as share of output. On the left in equation (4) are the outlays consisting of current public consumption spending, public investment and the current debt service. On the right are the sources of financing for these outlays; taxes -seigniorage and revenue taxes- as well as new borrowing.

In what follows we consider a simple form of golden rule that allows the policy-maker to run a deficit equal to the amount of public investment. Such a rule implies that only public investment can be paid for by public borrowing

$$d_t = g^i_t \tag{5}$$

A balanced-budget rule applies to current spending that has to be paid out of current revenues.

2.1 Characterization of equilibrium

Government and the central bank play a Nash game in both periods where the former's choice variables are public spending (both the level and the composition) and the tax rate and that of the latter is inflation. The model is solved recursively starting from $t = 2$. Both d_t and g^i_t are chosen only in $t = 1$ given that both debt re-payments and return on public investment are due with one period lag and $t = 2$ is the final period. Table 1 presents the equilibrium outcomes.

[5] Ismihan and Ozkan (2004) explore the real effects of central bank independence in a simplified framework which abstracts from public debt considerations.

Table 1. Macroeconomic outcomes under the golden rule ($g_1^i = d_1$)

Variable	$\phi_{\overline{x}_2}$	$\phi_{\overline{g}_2^c}$	$\phi_{\overline{x}_1}$	$\phi_{\overline{g}_1^c}$	$\phi_{\overline{g}_1^i}$
π_1	0	0	$\frac{1}{\alpha}\frac{1/\mu_1}{S}$	$\frac{1/\mu_1}{S}$	0
$g_1^i = d_1$	$\frac{1}{\alpha}\Psi F$	ΨF	0	0	Ψ
$(\overline{g}_1^i - g_1^i)$	$-\frac{1}{\alpha}\Psi F$	$-\Psi F$	0	0	Ψ^*
$(\overline{g}_1^c - g_1^c)$	0	0	$\frac{1}{\alpha}\frac{1/\delta_2}{S}$	$\frac{1/\delta_2}{S}$	0
$(\overline{x}_1 - x_1)$	0	0	$\frac{1}{\alpha}\frac{1/\alpha}{S}$	$\frac{1/\alpha}{S}$	0
π_2	$\frac{1}{\alpha}\frac{1/\mu_1}{S}\Pi$	$\frac{1/\mu_1}{S}\Pi$	0	0	$-\frac{1/\mu_1}{S}\psi_N\Psi$
$(\overline{g}_2^c - g_2^c)$	$\frac{1}{\alpha}\frac{1/\delta_2}{S}\Pi$	$\frac{1/\delta_2}{S}\Pi$	0	0	$-\frac{1/\delta_2}{S}\psi_N\Psi$
$(\overline{x}_2 - x_2)$	$\frac{1}{\alpha}\frac{1/\alpha}{S}\Pi$	$\frac{1/\alpha}{S}\Pi$	0	0	$-\frac{1/\alpha}{S}\psi_N\Psi$

Note: For any variable, say w_t, the outcome can be stated as follows: $w_t = \phi_{\overline{x}_2}\overline{x}_2 + \phi_{\overline{g}_2^c}\overline{g}_2^c + \phi_{\overline{x}_1}\overline{x}_1 + \phi_{\overline{g}_1^c}\overline{g}_1^c + \phi_{\overline{g}_1^i}\overline{g}_1^i$. Also note that $\psi_N = \psi - (1+r_1)$, $S = \frac{1}{\alpha^2} + \frac{1}{\delta_2} + \frac{k}{\mu_1}$, $S^* = \frac{1}{\alpha^2} + \frac{1}{\delta_2} + \frac{\delta_1}{\mu_1^2}$, $\widehat{\beta}_G = \beta_G \frac{S^*}{S}$, $F = \frac{1}{\delta_3 S}\psi_N \widehat{\beta}_G \gtreqless 0$ if $\psi_N \gtreqless 0$, $\Psi = 1/(1+\psi_N F) > 0$, $\Psi^* = 1 - \Psi > 0$ and $\Pi = 1 - \psi_N F \Psi > 0$.

Table 1 should be read as follows. Each row presents the equilibrium solution for the variable in that row in reduced form. Thus each entry is the coefficient of the parameter in that column in the solution for the variable in that row. The first five rows denote outcomes for $t = 1$ and the following three outcomes in $t = 2$. Note that outcomes are defined as gaps between the actual and the targeted values of the relevant variable except for inflation where the target value is 0. In what follows, we analyze the qualitative effects of a rise in g_1^c and g_1^i by working out the implications of a rise in $\overline{g}_1^c$ and $\overline{g}_1^i$ as $\partial g_1^c/\partial \overline{g}_1^c$ and $\partial g_1^i/\partial \overline{g}_1^i$ are always positive.

2.2 Discussion

Outcomes presented in Table 1 suggest that there are clear differences between the implications of current spending and public investment. Given that under the golden rule public investment is fully financed by public borrowing, it has no contemporaneous effect on macroeconomic performance; $\partial \pi_1/\partial \overline{g}_1^i = 0$, $\partial(\overline{g}_1^c - g_1^c)/\partial \overline{g}_1^i = 0$ and $\partial(\overline{x}_1 - x_1)/\partial \overline{g}_1^i = 0$. In contrast, current spending has to be paid out of current taxation -either revenue or inflation tax- and taxes are distortionary; higher revenue taxes reduce output and higher inflation is undesirable. Thus, public consumption has an *un*favourable contemporaneous effect on macroeconomic performance, $\partial \pi_1/\partial \overline{g}_1^c > 0$ and $\partial(\overline{x}_1 - x_1)/\partial \overline{g}_1^c > 0$.

As to the intertemporal implications of capital spending, there are two channels through which public investment committed today affects future outcomes. One is the direct effect; expanding public investment in $t = 1$ expands the productivity and thus equilibrium output -and hence the tax base- in $t = 2$. The greater the productivity coefficient, ψ, the larger the scale of output expansion in $t = 2$. The second is the indirect effect arising due to the implications of servicing the public debt in $t = 2$ that was raised in $t = 1$ to pay for the public investment. Clearly, the first effect is favourable and the second is unfavorable. It follows that, therefore, the overall impact of public investment would be determined by the net productivity effect, $\psi_N = \psi - (1 + r_1)$. This can be seen from Table 1. The three values in the last column corresponding to $\pi_2, (\overline{g}_2^c - g_2^c)$ and $(\overline{x}_2 - x_2)$ are all unambiguously negative functions of ψ_N, suggesting a favourable effect in the presence of positive net productivity. That is, expanding public investment in $t = 1$ makes the policy-maker better off in $t = 2$ only when $\psi_N > 0$.

When the net productivity effect is negative, a rise in capital spending leads to a worse outcome in $t = 2$; raising all three of inflation, current spending and output gaps. This is because the resources required to re-pay the debt more than offsets the return from public investment. The shortfall has to be paid out of higher taxes and/or higher inflation forcing the policy-maker face a worse policy trade-off in $t = 2$. The outcome is therefore a deterioration in welfare given that welfare losses increase with increases in deviations of inflation, output and public spending from target levels.

The following proposition formalizes these relationships.

Proposition *Under the golden rule, the effect of public investment undertaken in $t = 1$ on the macroeconomic performance in $t = 2$ depends on the net benefit of public spending, ψ_N.*

i) The higher is public investment in the first period the lower is the inflation rate, public consumption gap and output gap; hence, the better is macroeconomic performance in the final period, if $\psi_N > 0$.

ii) A change in public investment in the first period does not affect the macroeconomic performance in the final period, if $\psi_N = 0$.

iii) The higher is public investment in the first period the worse is macroeconomic performance in the final period, if $\psi_N < 0$.

Proof. The derivative of π_2 with respect to $\overline{g}_1^i$ is $-\frac{1/\mu_1}{S}\psi_N\Psi$, and this derivative is unambiguously negative/zero/positive when $\psi_N > 0$ / $\psi_N = 0$ / $\psi_N < 0$, respectively. Similarly, the derivative of $(\overline{g}_2^c - g_2^c)$ with respect to $\overline{g}_1^i$ is $-\frac{1/\delta_2}{S}\psi_N\Psi$, which is again negative/zero/positive when $\psi_N > 0$ / $\psi_N = 0$ / $\psi_N < 0$, respectively. The derivative of $(\overline{x}_2 - x_2)$ with respect to $\overline{g}_1^i$ is $-\frac{1/\alpha}{S}\psi_N\Psi$, which is also unambiguously negative/zero/positive when $\psi_N > 0$ / $\psi_N = 0$ / $\psi_N < 0$, respectively. $\blacksquare$

3 Concluding remarks

In countries where return from investment is low relative to the cost of public borrowing, expanding public investment is likely to deteriorate the overall macroeconomic environment with obvious adverse consequences for debt dynamics. Our results, therefore, suggest that policy-makers should focus on the quality -the productivity- of public investment not just its level.

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