

Hakhu, A. Bhatt; Sardoni, Claudio

Article

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European Journal of Economics and Economic Policies: Intervention (EJEEP)

Provided in Cooperation with:

Edward Elgar Publishing

Suggested Citation: Hakhu, A. Bhatt; Sardoni, Claudio (2021) : Public expenditure and growth: the Indian case, European Journal of Economics and Economic Policies: Intervention (EJEEP), ISSN 2052-7772, Edward Elgar Publishing, Cheltenham, Vol. 18, Iss. 1, pp. 77-101, <https://doi.org/10.4337/ejeep.2020.0068>

This Version is available at:

<https://hdl.handle.net/10419/277500>

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Public expenditure and growth: the Indian case*

A. Bhatt Hakhu

Statistics Specialist, Research and Data Section, UN WOMEN, New York, NY, USA

C. Sardoni

Honorary Professor of Economics, Sapienza University of Rome, Italy

The paper deals with the relationship between public spending and growth as well as the dynamics of the ratio of public debt to GDP. The authors show that a composition of public spending that favors productive expenditures, that is, those with a direct positive effect on the economy's long-run rate of growth, can determine a situation in which the ratio of public debt to GDP is stable, even though the government runs primary deficits. We test our theoretical results by considering the Indian case. Our empirical analysis substantially supports the idea that the dynamics of the economy as well as of the public-debt ratio are contingent on having a public sector that favors productive expenditures.

Keywords: *public expenditure, growth, public debt*

JEL codes: *H30, H54, H60*

1 INTRODUCTION

Across developed and developing countries alike, substantial fiscal turbulence has been seen in the post-global-financial-crisis period. As public debts rise, governments have responded by exercising fiscal austerity in the hope that austerity of any kind will reduce fiscal deficits and public debt eventually. However, such assumptions ignore the long-run relation between public spending, its composition and the rate of growth of the economy.

Over the years, many researchers have dealt with the relationship between public expenditure and growth at the theoretical as well as the empirical level. Many have concentrated their attention on the composition of public spending and its effects on the economy's long-run rate of growth by distinguishing between productive and unproductive public expenditures. Productive public expenditures are generally identified with public investment while unproductive public expenditures are identified with public consumption and regarded as having a nil, if not negative, effect on the rate of growth. Connected to this debate on public expenditure and growth is the discussion of its financing and its impact on the dynamics of the ratio of the public debt to GDP when the government runs a deficit.

In this paper, we contribute to the above-mentioned topics by showing that an adequate composition of the public expenditure, that is, an adequate ratio of productive to unproductive expenditures, can determine a rate of growth that is compatible with a stable public-debt ratio

* A previous version of this paper was presented at a session of the 21st FMM Conference in Berlin, Germany. The authors would like to thank the participants in the sessions for their comments, and two anonymous referees of the journal for their very helpful suggestions.

Received 9 August 2019, accepted 28 April 2020

over time, even though the government keeps on running deficits. This is done by using a simple analytical framework largely inspired by two pioneering articles by Domar (1944; 1946).

The functional relation between public spending and the economy's rate of growth can, of course, be studied also by following different analytical and theoretical approaches. We believe, however, that the one we chose has a number of advantages. First, our model does not require particular hypotheses about the investors' and consumers' behavioral functions. Second, the model, by emphasizing the importance of productive expenditures, allows us to concentrate on the effects of changes in the composition of public spending rather than on its increases. To consider the possibility that increases in public spending ensure that the public-debt ratio remains stable requires the adoption of a private investment function highly sensitive to demand and dealing with the problem of the size of fiscal multipliers. Our model does not require dealing with these issues.

We test our theoretical results by considering the Indian case. The Indian case, which has attracted the attention of many researchers, is an interesting case for several reasons. Despite a sustained increase in public debt and deficits for the period analysed, the Indian economy has experienced high rates of growth. Additionally, the Indian economy is characterized by a relevant share of public spending devoted to productive expenditures. Our empirical analysis shows that, although private-capital formation remains crucial for growth, the ratio of public debt to GDP can be stabilized in the long run if public spending is allocated to the financing of public investment to a significant extent.

The paper is organized as follows. Section 2 is devoted to a brief selective survey of recent literature concerning the issues on which our paper focuses. Section 3 presents a model in which a functional relation between public spending and the long-run rate of growth is introduced. Section 4 links the analysis of Section 3 to the problem of the stabilization of the ratio of public debt to GDP. In Section 5 we consider the Indian case to test our theoretical results by using vector autoregressions (VARs) and impulse response estimates. Section 6 concludes.

2 SOME RECENT CONTRIBUTIONS ON PUBLIC SPENDING, GROWTH, AND THE PUBLIC DEBT

In the context of the more general debate on the impact that the public sector has on the economy and its rate of growth, the problem of the composition of public spending has stimulated a large body of both theoretical and empirical literature, which distinguishes between productive and unproductive public expenditures, with the former generally identified with public investment and the latter with public consumption.

Devarajan et al. (1996), in a seminal contribution, establish a direct relationship between productive components of public expenditure and growth. In a dynamic optimization framework, they demonstrate that, until an optimal level of productive expenditures is reached, it is worthwhile to increase them. Glomm/Ravikumar (1997) review the relationship between productive public expenditure and growth by using endogenous growth models as proposed by Arrow/Kurz (1970), Barro/Sala-i-Martin (1990), and Glomm/Ravikumar (1994).¹ They disaggregate total expenditures into those that enter

1. Arrow/Kurz (1970) developed a model where consumers derive utility from private consumption as well as from the public capital stock. Barro/Sala-i-Martin (1990) and Barro (1991) introduce government expenditure into their models and distinguish between public consumption and public investment expenditure; in these models, however, public spending affects only the economy's transitional rate of growth, while the steady-state rate remains unaltered.

as inputs in the production function (infrastructures) and those that enter as inputs in investment technologies such as expenditures on education.

Many empirical studies have analysed the impact of public expenditure on growth without reaching a general consensus on the results obtained.² For the USA, daSilvaCosta et al. (1987), Aschauer (1989), and Munnell (1990) find a significant impact of the public capital stock on private-sector productivity.³ Later studies, such as Tatom (1991), Evans/Karras (1993), and Sturm/DeHaan (1995), question the production function approach in testing the public expenditure and growth relation and find little evidence of an impact of public capital on the productivity of the private sector.

More recently, Bose et al. (2007) examine the growth effects of government expenditure for a panel of 30 developing economies with a focus on sectoral expenditures during the 1970s and 1980s. Their main empirical result is that the ratio of government capital expenditure to GDP is positively and significantly correlated with economic growth, while the growth effect of current expenditure is not significant for a large group of countries.

Attention has been paid also to the problem of the existence of an optimal share of public capital spending, beyond which a shift from current to capital expenditures might lower the economy's rate of growth (Devarajan et al. 1996). In other words, there is the possibility that public investment has a crowding-out effect (Buiter 1998). Warner (2014) finds a negative relationship between public investment booms and private investment rates and concludes that public investment crowds-out private capital formation. Others, however, support the idea that public investment can have a crowding-in effect. Cavallo/Daude (2011) use a panel of 116 developing countries and show that the effect of public investment on its private counterpart depends on the quality of private institutions in the country.⁴

Several contributions also take into consideration the dynamics of public debt. Gupta et al. (2005) test the effects of fiscal consolidation and expenditure composition on economic growth in a sample of 39 low-income countries during the 1990s. The results show a strong link between public expenditure and growth, as fiscal consolidations achieved through cuts of current expenditures are, in general, more conducive to growth. Larger current expenditures and domestic financing of the deficit are associated with less favorable economic performances.⁵

Minea/Villieu (2013) look at the long-run growth effect of borrowing for public investment in the light of a model developed by Futagami et al. (2008). Carranza et al. (2014) look at the relationship between fiscal consolidation and public investment in six of the main Latin American economies. They find that simple austerity measures that focus on cuts in current expenditures may not be appropriate for fiscal consolidation. Gupta et al. (2014), by considering a panel of low-income economies, find that the quality of public investment is statistically significant in explaining variations in economic growth.

2. Bom/Ligthart (2014) survey a considerable number of empirical studies by using meta-regression analysis. They point to a number of factors that can explain the low degree of consensus reached so far.

3. Aschauer (1989) argues that there is a strong and positive relationship between productivity and the ratio of public to private stock between 1949 and 1985 in the US and that the decline in productivity of the 1970s was due to low public investment spending.

4. In countries where openness to trade and financial flows are large and public institutions are good, there exists a complementarity between public and private investment. Khan/Kumar (1997) argue that some components of public expenditure may be complementary to private investment. For instance, public investment in infrastructure and human capital formation can increase the productivity of private capital.

5. Empirical literature with similar results includes Landau (1983) and Summers et al. (1984).

On the contrary, Warner (2014), by using a sample of 124 lower- and middle-income countries, holds that in most cases there is a low association between public investment booms and economic growth. Greiner (2012) uses a simple endogenous growth model allowing for deficits and debt to show that when government adjusts public spending to meet the inter-temporal budget constraint, long-run growth is slower. However, when lump-sum transfers are introduced, there is no impact of the public-debt ratio on the long-term growth rate.

Checherita-Westphal/Rother (2012) argue that the relationship between growth and debt is non-linear, at least in the case of the EU12, since 1970. The channels through which this impact is observed are private saving, public investment, and total factor productivity. Panizza/Presbitero (2014) use a panel of OECD countries to look at the links and the causal relationship between economic growth and public debt. Their results are consistent with other studies where a negative correlation between the two variables is found. However, studies such as Herndon et al. (2014) do not find such a causal relationship in analysing the data for the same set of countries during a similar period of time, even if a negative correlation exists.

The literature surveyed above is mostly mainstream. The basic features of the theoretical and empirical models used are standard. There are, however, several recent contributions that relate to different traditions of thought and, in particular, to Keynesian/post-Keynesian economics. Pasinetti (1998) criticizes the Economic and Monetary Union's (EMU) Maastricht 3 percent deficit and 60 percent public-debt constraints and shows that those parameters are not necessarily those required for the sustainability of the ratio of the public debt to GDP. Michl (2009), in the classical/Marxist tradition, deals with growth, fiscal policy, and public debt by examining the cases in which the debt can have negative distributive effects. Seccareccia (2012) discusses the modern 'financial balances' view of fiscal policy and argues in favor of a return to Keynes's view of long-term fiscal policy, which emphasizes the role of public investment as a tool to promote long-term growth. Ryoo/Skott (2013), by using a stock-flow consistent model, examine the fiscal requirements to maintain full employment and the implications for the dynamics of the public-debt ratio. Skott (2016), on the assumption that, in the long run, fiscal policy is required to ensure full employment, argues that the long-run dynamics of the public debt depends, among other things, on the composition of public spending. Mazzucato (2014) looks at several empirical cases in which direct or indirect state interventions have contributed significantly to raise productivity by promoting innovations through public spending.

With the exception of Michl and Mazzucato,⁶ all the non-mainstream works mentioned above make no explicit reference to Domar's contribution, despite the fact that he carried out his analysis within a Keynesian framework. In light of the above, in the next section we build on Domar's contribution to deal with the problems of growth, public spending, and the sustainability of the public-debt ratio.

3 PRODUCTIVE PUBLIC SPENDING AND GROWTH: THE ANALYTICAL FRAMEWORK

In this section we carry out our analysis by developing a model of growth with a public sector which is largely inspired by Domar's pioneering contributions in the 1940s (Domar 1944; 1946). In our view, Domar's approach to growth and public debt has three major

6. Mazzucato (2014: 33), however, regards Domar's model of growth as neoclassical - a view that we do not share.

merits. First, it allows us to rely on a ‘frugal’ analytical construct, in the sense that it does not require any particular hypotheses about the investors’ and consumers’ behavioral functions. Second, in Domar’s analysis of growth the productivity of investment plays a crucial role and it can be extended to consider public investment too. Third, it makes it easier to analyse the effects of public spending on growth under the assumption that the ratio of government deficit to GDP is maintained constant over time while the composition of public expenditures varies.⁷

3.1 Domar’s contribution

In the 1940s, Domar published two important articles. The first (Domar 1944) was concerned with the ‘burden’ of the public debt; the second (Domar 1946) presented a model for the determination of the long-run equilibrium rate of growth. Domar (1944) criticizes the idea that deficit spending necessarily leads to an ever-growing public debt, the servicing of which implies an increasing tax burden on the economy. For Domar, while all previous analyses underlined the obvious fact that continuous borrowing results in an ever-increasing debt, many tended to overlook that deficit spending affects income (Domar 1944: 801).

By considering a case in which it is assumed that income grows at a constant rate g and the government, which runs a deficit, borrows a percentage α of income, Domar shows that the rate of growth of the public debt will approach the growth rate of income and, therefore, the ratio of the public debt to income will tend to a constant value $\frac{\alpha}{g}$ (ibid.: 809). It follows that the larger is the rate of growth of income, the lower is the ultimate ratio of debt to income.⁸ Domar (1946) deals with the problem of growth in a more thorough way and determines the equilibrium long-run rate of growth (the well-known $g = \sigma$), but there he does not take into consideration the public sector.

In Domar’s view, the problem of the debt ratio lies in the ability to make income grow rather than in attempting to reduce it without taking account of the effects of such a reduction on income.⁹ A certain growth rate of income can be achieved if aggregate demand grows at that rate and, at the same time, a sufficient amount of the expenditures is directed toward ‘increasing the efficiency of production, so as to allow the required volume of monetary expenditures to take place without a rise in prices’ (Domar 1944: 820). The government can contribute to increasing the economy’s growth rate by converting part of the private income that it absorbs through taxation into productive expenditures. For simplicity, such expenditures can be thought of as public investment, as opposed to current expenditures seen as unproductive.

Domar (ibid.: 820), however, is careful to point out that the distinction between investment and current expenditure may be misleading: ‘As a matter of fact, the term “investment expenditures” may be misleading, because it is too closely associated with steel and concrete. If healthier people are more productive, expenditures on public health

7. This section is partly based on Saroni/Palazzi (2000).

8. See the mathematical appendix to Domar’s article.

9. ‘Now, some economic and political circles are burning with a desire to reduce the debt burden. ... They recognize no other method of achieving their goal but by reducing the absolute size of the debt; that the government must stop borrowing is of course taken for granted. They should beware, however, lest the policies they advocate exert such a depressing effect on the national income as to result in an actually heavier debt burden, even though they succeed in paying off a part of the debt’ (Domar 1944: 815–816).

satisfy these requirements. The same holds true for expenditures on education, research, flood control, resource development and so on.’

Domar, however, did not provide analytical support for his intuition concerning the functional relation between public productive expenditures and the economy’s rate of growth. Below, we develop his intuition by introducing a functional relationship between the composition of public spending and the economy’s rate of growth.

3.2 Productive public spending and the equilibrium rate of growth

Central to our analytical construct is the distinction between productive and unproductive public expenditures as defined below.

Productive public expenditures All those government expenditures that affect the economy’s long-run growth rate through their effects on the economy’s productivity. We shall denote these expenditures as *public investment*.¹⁰ It is important to note, however, that in defining productive public expenditures theoretically, other expenditures that affect the economy’s productivity both directly and indirectly could be included. In other words, in addition to capital spending in the form of infrastructure building, expenditures that contribute to economic growth through building of human capital (transfer payments to poor households for education of their children, conditional cash transfers, etc.) can also be included. As discussed later, in Section 5, the empirical definition of productive public expenditure is much more restrictive as it emanates from the standardized categories into which government expenditures are budgeted for accounting purposes: namely, public consumption and public investment.

Unproductive public expenditures All the other government expenditures, which we shall denote as *public consumption*.

Let us consider a closed economy with a public sector that spends on goods and services and levies taxes. For now, we consider only cases in which the public budget is in balance and there is no past public debt.

For the economy to be in equilibrium over time, it must be

$$Y' = \frac{dY}{dt} = \frac{dP}{dt} = P', \quad (1)$$

where Y is aggregate demand and P is the aggregate potential productive capacity.

If the productivity of investment I is denoted by σ , we have

$$\sigma = \frac{\frac{dP}{dt}}{I} = \frac{P'}{I}, \quad (2)$$

that is,

$$P' = \sigma I.$$

10. The term ‘public investment’ is interpreted as inclusive of all those current expenditures that are technically associated with capital expenditures (maintenance, repairs, etc.).

Let us now consider public spending by distinguishing between productive public expenditures (public investment), I_g , and unproductive public expenditure (public consumption), C_g , so that

$$G = I_g + C_g$$

and

$$G' = I'_g + C'_g,$$

where G is total public expenditure.

Unproductive public expenditures are assumed to be a certain share a of the total fiscal revenue, tY , that is:

$$C_g = atY$$

and

$$C'_g = atY'.$$

For now, we assume that the productivity, σ_g , of public investment I_g and the productivity of private investment I_p , σ_p , are equal, that is:

$$\sigma_g = \frac{P'}{I_g} = \sigma_p = \frac{P'}{I_p} = \sigma$$

so that

$$P' = \sigma(I_g + I_p). \quad (3)$$

The equilibrium condition (1) can now be written as

$$Y' = (1-s)(1-t)Y' + I'_p + I'_g + atY' = P' = \sigma(I_g + I_p), \quad (4)$$

where s is the private marginal propensity to save and t is the average tax rate, which are both taken as given and constant.

From (4) we obtain the equilibrium rate of growth

$$g = [(1-t)s + t(1-a)]\sigma. \quad (5)$$

g is increasing in σ and it is decreasing in a : the larger is the share of fiscal revenue devoted to unproductive spending the lower is the economy's equilibrium rate of growth. $(1-t)s + t(1-a)$ denotes the overall marginal propensity to save.¹¹

It is interesting to notice that the rate of growth may be increasing also in the tax rate t ; in fact it is

$$\frac{\partial g}{\partial t} > 0 \quad \text{if} \quad (1-s) > a. \quad (6)$$

11. It could be hypothesized that a share A of unproductive expenditures is independent of the fiscal revenue, so that it would be $C_g = A + atY$. This hypothesis, however, would not alter our general results significantly as it would only yield a lower equilibrium rate of growth, $g_A = [(1-t)s + t(1-a)]\sigma - A$.

Since a can be interpreted as the public propensity to consume, condition (6) tells us that an increase in the tax rate is associated with a higher equilibrium growth rate if the public propensity to consume, a , is lower than the private propensity to consume, $(1 - s)$. If (6) holds, an increase in the tax rate t necessarily implies a higher overall propensity to save and equilibrium requires a higher growth rate of investment and, hence, a higher rate of growth of the economy.

From (5), it is clear that, given s and t , the equilibrium rate of growth reaches its maximum at $a = 0$, that is, when unproductive public spending is totally eliminated. This, however, does not seem to be a realistic possibility because there are some public expenditures that must necessarily be made by the government, irrespective of their economic impact. Therefore, we impose that

$$0 < \bar{a} \leq a < 1, \quad (7)$$

where \bar{a} denotes the share of fiscal revenue that must be devoted to unproductive public expenditures.¹²

Condition (7) implies that the rate of growth g reaches its maximum \bar{g} , when $atY = \bar{a}tY$,

$$\bar{g} = [(1 - t)s + t(1 - \bar{a})]\sigma. \quad (8)$$

There is also another constraint to take into account. It derives from the assumption of a balanced public budget. This constraint imposes that

$$I_g + \bar{a}tY = tY,$$

that is to say, the maximum value that I_g can take is

$$\bar{I}_g = \frac{(1 - \bar{a})I_p t}{1 - s(t - 1) + t(\bar{a} - 2)}. \quad (9)$$

So far, we have assumed that the productivities of public and private investment are the same and that the productivity of private investment is independent of productive public expenditure. Now we remove these hypotheses.

First, we lift the hypothesis $\sigma_g = \sigma_p$. If $\sigma_g \neq \sigma_p$, the average total investment productivity is

$$\sigma = \frac{I_p \sigma_p + I_g \sigma_g}{I_g + I_p}, \quad (10)$$

that is, it is the weighted average of σ_p and σ_g .

If it is assumed that $\sigma_g > \sigma_p$, total productivity σ is increasing in I_g .¹³ But I_g is constrained to ensure that the public budget is in balance; condition (9) has to be satisfied. Therefore, the maximum value for σ is

12. We can define these unproductive expenditures as necessary. Obvious examples are public spending on defense, public order, etc. Introducing this constraint on unproductive expenditures, which implies a lower growth rate, gives the same general result as making the hypothesis that a share of unproductive spending is independent of the fiscal revenue (see footnote 11).

13. $\frac{\partial \sigma}{\partial I_g} = \frac{I_p(\sigma_g + \sigma_p)}{(I_g + I_p)^2} > 0$ if $\sigma_g > \sigma_p$.

$$\bar{\sigma} = \frac{I_p \sigma_p + \bar{I}_g \sigma_g}{I_g + \bar{I}_p}. \quad (11)$$

If we also abandon the hypothesis that σ_p is independent of I_g and, instead, we assume that it is increasing in I_g , the conclusions above do not change significantly, but we obtain a larger maximum value for the average total productivity. Assume that

$$\sigma_p(I_g) = hI_g^{1/2} \quad \text{with} \quad h > 0, \quad (12)$$

that is to say, the productivity of private investment is increasing in the productive public expenditures, but at a decreasing rate.

σ_p reaches its maximum $\bar{\sigma}_p$ when I_g reaches its maximum \bar{I}_g ,

$$\bar{\sigma}_p = h\bar{I}_g^{1/2}.$$

The maximum value of σ now is

$$\bar{\sigma} = \frac{h\sqrt{\bar{I}_g}I_p + \bar{I}_g\sigma_g}{\bar{I}_g + I_p} \quad (13)$$

and the maximum rate of growth that the economy can realize is

$$\begin{aligned} \bar{g} &= \chi \bar{\sigma} \\ \chi &= [(1-t)s + t(1-\bar{a})]. \end{aligned} \quad (14)$$

3.3 Introducing deficits and public debt

We now consider a case in which the government runs a deficit and there is a positive public debt. Since in dealing with the public debt the relevant variable is its ratio to GDP, from now on we express all the fiscal variables in terms of their ratios to GDP, Y .

The ratio of total public expenditure to Y is

$$\gamma = \gamma_1 + \gamma_2 + rb,$$

where $\gamma_1 = \frac{I_g}{Y}$ denotes the ratio of productive expenditures to Y ; $\gamma_2 = \frac{C_g}{Y}$ is the ratio of unproductive expenditures to Y and $rb = r\frac{B}{Y}$ is the ratio of interests on the public debt to Y (r is the interest rate and B is the total public debt).

Let us express the government budget as

$$\gamma_1 + \gamma_2 + rb - \tau = d\tau, \quad (15)$$

where d is a scalar larger than zero.¹⁴

We retain the hypothesis that unproductive public expenditures are a certain proportion a of the fiscal revenue, with $0 < \bar{a} \leq a < 1$. Therefore,

$$\gamma_2 = a\tau$$

14. Obviously, if $d = 0$, the budget is in balance, and if $d < 0$, the government is running a surplus.

with $\tau = \frac{T}{Y} = t$ and

$$\gamma_1 = (d - a)\tau - rb. \quad (16)$$

The maximum value of γ_1 is

$$\bar{\gamma}_1 = (d - \bar{a})\tau - rb. \quad (17)$$

Clearly, $\bar{\gamma}_1$ is increasing in d and decreasing in r and b .

If the productivity of private investment is increasing in the productive public expenditures, the functional relation between productive public expenditures and the productivity of total investment, σ , can be expressed as

$$\sigma = m\gamma_1^{1/2},$$

which reaches its maximum at

$$\bar{\sigma} = m\bar{\gamma}_1^{1/2} = m[(d - \bar{a})\tau - rb]^{1/2}. \quad (18)$$

Consequently, the economy's rate of growth is maximum when¹⁵

$$\bar{g}_b = \chi_b m [(d - \bar{a})\tau - rb]^{1/2}. \quad (19)$$

An economy in which the government is running a primary deficit necessarily experiences a growing public debt.¹⁶ Such a situation can be sustainable if the ratio of the public debt to GDP (b) is constant over time. As is well known, sustainability is ensured if the rate of growth obtained from equation (19) is larger than the rate of interest r on the public debt.¹⁷ In particular, we must have that, when the economy is at its maximum rate of growth \bar{g}_b , the latter must be larger than r to ensure sustainability, that is to say,

$$\bar{g}_b = \chi_b m [(d - \bar{a})\tau - rb]^{1/2} > r, \quad (20)$$

which is satisfied for

$$d\tau > r \left[b + \frac{r}{(\chi_b m)^2} \right] + \bar{a}\tau. \quad (21)$$

A constant ratio of public debt to Y can be realized despite a persistent government deficit, but only if this deficit ($d\tau$) is sufficiently large. The government deficit required to ensure a stable ratio of public debt to GDP is increasing in r , b , and \bar{a} , whereas it is decreasing in χ_b (the economy's overall propensity to save) and in m (the sensitivity of investment productivity to productive public spending, γ_1).¹⁸

15. Notice that χ_b in (19) is in general different from χ in (14). The difference depends on the presence of the interest paid on the public debt and accruing to the private sector. If the private propensity to save changes as a consequence of the interest payments received, then it is $\chi_b \neq \chi$.

16. For simplicity, we assume that there is no monetization of the debt.

17. For $g > r$ and $b > 1$, the ratio b of public debt to GDP converges to $\bar{b} = \frac{y-\tau}{g-r}$.

18. Condition (21) regards the government total deficit. The condition expressed in terms of the primary deficit is $d\tau - rb > \frac{r}{(\chi_b m)^2} + \bar{a}\tau$, which also implies the condition that productive public expenditures must fulfill: $\gamma_1 > r \frac{r}{(\chi_b m)^2}$.

The above apparently counter-intuitive result depends on the fact that the deficit, net of the share devoted to the financing of necessary unproductive expenditures ($\bar{a}\tau$) and of the amount devoted to the payment of interests ($r\bar{b}$), which are both given, is entirely devoted to the financing of productive expenditures. Since the economy's rate of growth is increasing in productive expenditures, it follows that the government deficit must be sufficiently large to ensure that productive expenditures are sufficiently large to guarantee a rate of growth higher than the rate of interest on the public debt.

From the above it follows that the ratio of public debt to GDP could be stabilized by increasing the ratio of public deficit to GDP. A situation in which the economy is experiencing a growing public-debt ratio (condition (21) above is not satisfied) can be transformed into one in which the public debt ratio is stabilized thanks to an increase in public expenditure and in the public-deficit ratio, d , so that (21) is fulfilled. This, however, is true *provided that* the increase in spending is devoted to productive expenditures. If, instead, the increase in deficit is due to an increase in unproductive spending (that is, an increase in \bar{a}), the result would contribute to an acceleration in the growth of the debt ratio, because of the decrease in the economy's rate of growth (see equation (19) above).

If the maximum rate of growth that the economy can realize is lower than r , it is impossible to stabilize the public-debt ratio through changes in the composition of public spending. In such a case, the stabilization of the debt ratio can be obtained through the realization of primary surpluses or the reduction of the interest rate, as prescribed by the mainstream analysis of the dynamics of the public debt.

3.4 Some concluding considerations

The different rates of growth considered in this section are all transformations of Domar's equilibrium rate of growth for a closed economy with no public sector, $g = \sigma s$ (Domar 1946), and they retain the same basic properties.

1. The equilibrium rate of growth is increasing in the productivity of investment σ . In an economy with a public sector, the overall productivity of investment can be raised through an increase in productive public expenditures.
2. The equilibrium rate of growth is increasing in s , the overall propensity to save. In an economy with a public sector, the overall propensity to save can be increased if resources of the private sector are transferred to the public sector, which has a higher propensity to save than the private sector.

The second property is delicate and requires careful interpretation. That an increase in s or in $[(1-t)s + t(1-a)]$ implies a higher *equilibrium* rate of growth is obvious. The higher is the overall propensity to save, the larger must be investment, and hence the higher must be the growth rate, to ensure equality between aggregate demand and supply over time. From this, however, it should not be inferred that an increase in the overall propensity to save ensures, *per se*, an increase in the *actual* rate of growth. Decisions to save and decisions to invest are generally independent of one another. An increase in the propensity to save not accompanied by the required increase in investment would determine a lower aggregate demand with a negative impact on the actual rate of growth. However, when the public sector is considered, the increase in the public and overall marginal propensity to save translates itself directly into an increase in investment and, hence, in the rate of growth.

Domar's model determines the rate of growth of investment and productive capacity that the economy must realize to experience a sustainable process of growth over time.

The sustainable rate of growth is affected also by the government's behavior. An adequate proportion between productive and unproductive public spending can ensure a higher equilibrium rate of growth as well as a stable ratio of public debt to GDP.

4 THE IMPORTANCE OF DEBT STABILIZATION

In so far as private spending grows at a rate that is insufficient to guarantee long-run full employment, or a rate of employment regarded as socially and economically sustainable, public deficits are required. Persistent public deficits imply, of course, a growing public debt. This, however, does not necessarily mean that the ratio of the public debt to GDP must grow as well. Quite to the contrary, as we saw, the public-debt ratio can be kept stable over time, or even reduced. The growth over time of the debt ratio essentially denotes the failure of fiscal policy to promote growth.

A growing debt ratio denotes the fact that the public sector is spending in the wrong way, that is to say it is using resources in a way that does not contribute to the overall growth of the economy. In terms of our model, a growing debt ratio is a negative phenomenon because public spending is excessively devoted to unproductive uses.

If an increasing debt ratio is the outcome of the government's inability to promote an adequate rate of growth, this has to be regarded as the fundamental reason why the debt ratio needs to be stabilized, if not reduced, thanks to variations of the composition of public outlays in favor of productive expenditures. There are, however, other reasons why there must be concern for a large and growing public-debt ratio. A large and growing debt ratio increases the risk of speculative attacks against the state's debt. A conventional conviction that a certain state is on the verge of a default crisis because of its debt is usually a fertile terrain for speculation, which causes a fall in bond prices and an increase in interest rates and risk premia that, in turn, contribute to making the debt problem even more serious.¹⁹ In a situation in which the economy is not growing sufficiently to keep the debt ratio constant, both the deficit and the debt further increase for the wrong reason, that is, to pay interest rather than to promote productive expenditures.

For a long time, among mainstream economists and policy-makers, especially in Europe, the dominant view has been that if the debt ratio is high and increasing, there is only one way to stabilize it: to run primary surpluses. Such positions fail to see that 'austerity' measures can be counter-productive and give rise to perverse effects. Attempts at stabilizing the debt ratio through restrictive fiscal policies can determine the worsening of the debt problem because of their negative impact on the economy's aggregate output.

A significant part of public spending is endogenous and tends to increase as the economic conditions worsen, while, at the same time, tax revenues tend to decline. As a consequence, the budget deficit varies counter-cyclically. If the worsening of the deficit and the increase of the debt give rise to further restrictive fiscal policies with a negative impact on the output, there is the evident risk of entering a vicious circle. The situation is further aggravated by the fact that, typically, the expenditures that are most easily and rapidly cut are productive, such as investments in infrastructures.

Recently, however, starting from the realization that (especially negative) fiscal multipliers have been underestimated, there has been a growing concern about the negative

19. On this, see also Pasinetti (1997) and De Grauwe/Ji (2012), who find that recent rises in the spreads of a number of countries in the eurozone are essentially explained by 'market sentiment' rather than by increases in their debt ratios.

effects of the attempts at fiscal consolidation through cutting expenditures. In particular, and most important, the long-run negative effects of such policies have been pointed out.²⁰

We believe that the approach put forward in our paper can be a viable alternative solution to the important problem of the stabilization of public debt. Our approach is inspired by Domar's contributions. Domar strongly opposed the traditional fiscal consolidation attempts of his time.

5 PUBLIC EXPENDITURE, GROWTH, AND DEBT: THE INDIAN CASE

The Indian case has received considerable attention among economists interested in the relationship between public spending and growth. In this section, after a brief survey of the existing literature on the Indian case, we carry out an empirical analysis of Indian data with the objective of testing some of the analytical results obtained in Section 3.²¹

India is an interesting case for a number of reasons. First, the Indian economy, despite a sustained increase in public debt and deficits for the period analysed, has also experienced high rates of growth. This state of affairs appears to be consistent with our theoretical model, where the government runs a deficit and the public debt is positive but a composition of public spending that favors productive expenditures determines the possibility to have a stable ratio of public debt to GDP.

Second, our theoretical model explicitly differentiates between the productivity of public and private investment and considers the possibility that public investment is more productive than its private counterpart and that it also positively affects the productivity of private investment. Public-sector enterprises are a substantial component of the Indian economy and have significant resource and licensing advantages that can translate into significant productivity gains for them as against their private counterparts.

Third, the testing of our model requires an empirical case where public investment is a substantial component of public expenditures. This condition works well for the Indian case, given the fact that it is one of the fastest-growing emerging economies where policy-makers are consistently restructuring public expenditure components to keep pace with the political, economic, and developmental needs of the country.

5.1 A survey of the literature on India

By considering the case of India, Rangarajan/Srivastava (2005) show that the overall growth rate is dependent on the overall saving and investment rates. Thus, in the past, when government saving fell, the private savings rate increased by virtue of the fact that wealth held in the private sector as government bonds increased. On the investment side, public investment as a ratio of debt to GDP also fell while the ratio of interest payments to revenue receipts rose. Empirical analysis of the Indian data indicates that government capital expenditures responded inversely to interest payments and bore a direct relationship to revenue receipts. In the 1990s and after, the ratio of government capital expenditures to GDP fell not only because interest payments increased relative to GDP, but also because the ratio of fiscal revenues to GDP fell.

20. See, for example, DeLong/Summers (2012), Fatás/Summers (2018), and Gechert et al. (2019). Blanchard (2019) discusses the need for running fiscal deficits when monetary policy is subject to the zero lower bound as well as the risks of experiencing high levels of public debt.

21. Similar studies have been carried out for other countries. Bhatt Hakhu et al. (2016) is an example of evidence from the EU and finds that long-term debt sustainability in the EU is associated with the composition of public expenditure.

Asher (2012) reiterates the IMF style method to check for debt sustainability, according to which the Indian debt–GDP ratio should fall from 64.1 percent in 2010 to 61.2 percent in 2016. Most of this debt is internal and public-sector financial institutions are the key holders, thus there is less exposure to market risks. However, he warns that the primary deficit is persistent, and maintaining a large differential between the real interest rate and the GDP rate of growth will become more difficult.

Kaur/Mukherjee (2012) show that, in India, the relationship between public debt and growth is non-linear by using an estimation based on the inter-temporal budget constraint and a fiscal policy response function. They observe a cointegration between revenue and expenditure, and that the primary balance responds in a stabilizing manner to the increase in debt.

Buiter/Patel (2006), using the stationarity tests developed by Phillips/Perron (1988) and Kwiatkowski et al. (1992), argue that while deficits in India are large, the risk of a deficit-induced crisis is minimal. Jha/Sharma (2004) analysed this issue by using cointegration tests for public expenditure and revenue. Their empirical analysis suggests that the revenue and expenditure series are $I(1)$ and cointegrated with regime shifts. Thus, Indian public debt may not be unsustainable.

While the studies above employed only data for the central government, Goyal et al. (2004) analysed the same issues at all levels of government. They test for the stationarity of public debt in the same way as Buiter/Patel (2006) by employing the cointegration test developed by Gregory/Hansen (1996), which allows for structural breaks. The fiscal stance of the central and the state governments is unsustainable at the individual level, but it is weakly sustainable for the combined finances as inter-governmental financial flows are netted out.

Other works, such as Parker/Kastner (1993), Cashin et al. (1998), Cashin/Olekalns (2000), Callen/Cashin (2001), Reynolds (2001), Lahiri/Kannan (2002), Mohan et al. (2005), Rangarajan/Srivastava (2005), and Buiter/Patel (2006), analyse the problem of fiscal sustainability and most of them arrive at the result that the future path of the debt–GDP ratio appears to be unstable.

Thus, research on the subject of public debt sustainability for India, based on the analysis of government revenue and expenditure series does not show much consensus. Below we put forward our empirical analysis of the same problems by referring to the theoretical framework presented in Section 3.

5.2 The empirical analysis

We estimate a vector autoregression (VAR) on private capital formation, components of public expenditure, GDP growth, and public debt series, and show, on the basis of impulse response functions, that even if deficits are high, the ratio of public debt to GDP can be stabilized in the long run if most of the new public spending is on productive components. Private investment and public investment react sluggishly to public debt, but they seem to correct the debt disequilibrium in the long run.

5.2.1 Data and unit roots

Annual data available from the Reserve Bank of India are used for the period spanning 1961 to 2014.²² The productive component of public expenditure series is available from the Handbook of Statistics on the Indian economy (gross capital formation by

22. We include data only until year 2014 to avoid a potential break in series. In 2014, India's new government was elected and a number of new reforms simultaneously, particularly related to the macro economy, were introduced. These include introduction of several flagship programs on

the public sector). All the variables are converted into ratios by dividing by the nominal GDP of the respective year. However, for the purpose of the empirical analysis, the log value of real variables (in constant 2011 Indian rupees) is used. We follow the literature (Devarajan et al. 1996) and the theoretical model in Section 3 to define the productive component of public expenditure and private capital formation.

As mentioned in Section 3, public expenditure categories that boost productivity of human capital should also be included in productive expenditure given the empirical evidence on this topic (Annabi et al. 2011; Gemmel et al. 2016). Unfortunately, in the empirical exercise, current expenditures that have a productive component maybe classified as non-productive public expenditure because of the way in which expenditures are divided in the system of national accounts. The productive expenditure category in our analysis, thus, may suffer from a downward bias. The extent of this bias would be difficult to estimate given the fact that the efficiency of such expenditures can be a crucial determinant of whether or not, and by how much, human capital productivity increases in the long run.

In light of the above, productive expenditure by the government in this section of the paper only includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Descriptive statistics of the dataset for ratio to GDP variables are reported in Table 1.

Visual inspection of the data as presented in Figure 1 shows that the debt-to-GDP ratio (*PD*) was consistently rising until the early 1990s and that, afterwards, it was on a declining trajectory. However, in the early 2000s, the debt rose sharply to around 80 percent of GDP and has started stagnating since the global financial crisis in 2008.

Productive (*PPE*) and non-productive public expenditures (*NPE*) seem to be moving in conjunction with each other, starting from the early 1990s. However, the ratio to GDP has been consistently higher in the post-liberalization era. Finally, private-capital formation (*PCF*) has always been on an upward trajectory, although the series exhibits a number of peaks and troughs.

To compare and contrast the trajectory of the CPI-deflated values of the same variables, Figure 2 presents a graph of log values of CPI-deflated public debt (*LPD*), GDP (*LGDP*),

Table 1 Descriptive statistics, 1961–2014

Variable name	Mean	Std dev.	Min.	Max.
Public debt, in % of GDP	59.24	15.79	32.69	83.23
Gross fiscal deficit, in % of GDP ^a	7.55	1.37	4.00	9.60
Gross primary deficit, in % of GDP ^a	2.91	1.89	-1.20	8.10
Consumption, in % of GDP ^a	66.65	6.35	55.69	78.11
Private capital formation, in % of GDP ^a	14.50	6.38	7.25	27.91
Productive public expenditure, in % of GDP ^a	8.34	1.60	5.80	12.23
Non-productive public expenditure, in % of GDP ^a	10.85	1.11	8.53	12.79

Note: a. 1981–2014.

financial inclusion such as Prime Minister's Jan Dhan Yojana (PMJDY), new value added tax known as the GST, change in approach to inflation targeting, focus on reducing non-performing assets of public-sector banks and the recent demonetization.

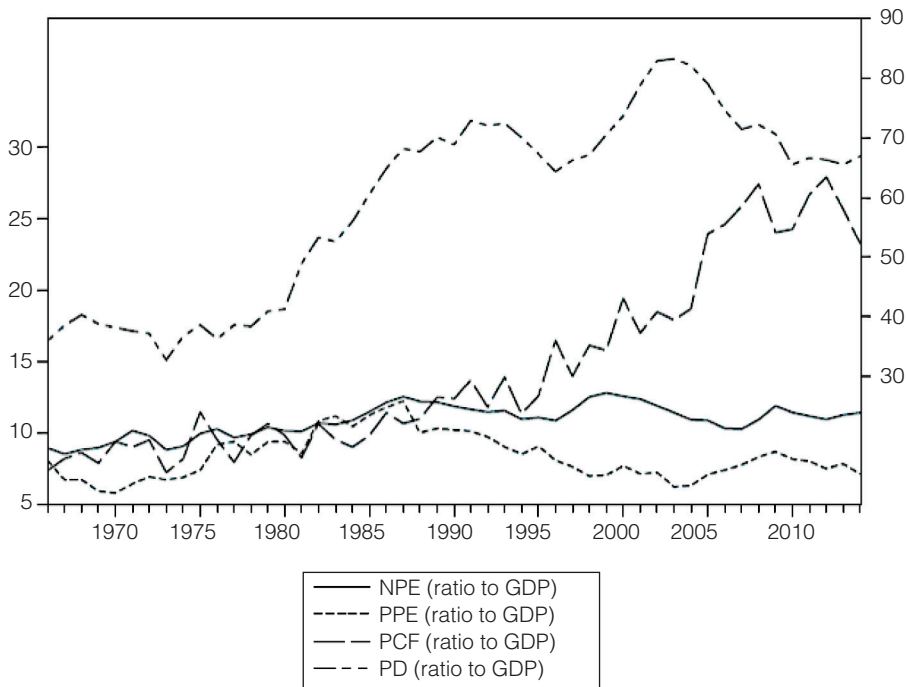


Figure 1 Time trends of key ratios to GDP variables, 1961–2014

private-capital formation (*LPCF*), public consumption (*LNPE*), public investment (*LPPE*), and deficits (*LDEF*). The deficit series shows a dip around 2008 when the effects of the Fiscal Responsibility and Budget Management Act (FRBMA) would have come into effect.²³ All the other variables show a constantly rising trajectory.

To test for the presence of unit roots in the data, the CPI-deflated values are used. The Zivot–Andrews test, which allows for one endogenous break, was used (Zivot/Andrews 1992). This test has the advantage of allowing for a break and calling for a null with a unit root with a structural break in intercept, trend, or both. The presence of breaks in the debt series are expected, because the time period under examination includes fiscal responsibility legislation in the early 2000s, when the central government introduced the FRBMA. On the basis of this test, there appear to be breaks only in the LPD series in both levels and trends. The break period coincides with the timing of the FRBMA.

With regard to *LPCF*, which does not appear to exhibit breaks, the Elliott–Rothenberg–Stock ADF–GLS test, which is more efficient than other tests under the hypothesis of normal residuals, was used (Elliot et al. 1996). The optimal number of lags was selected on the basis of the Schwartz information criterion and keeping in mind the normality of the residuals. The results (not reported) show that the series follow an I(1) process. As for

23. The FRBMA is an act of the Parliament of India which aims at working towards reducing India's fiscal deficit to below 3 percent of GDP. The decrease in deficit was to be achieved by the central government through encouraging state governments to undertake prudent fiscal management and control unchecked borrowings.

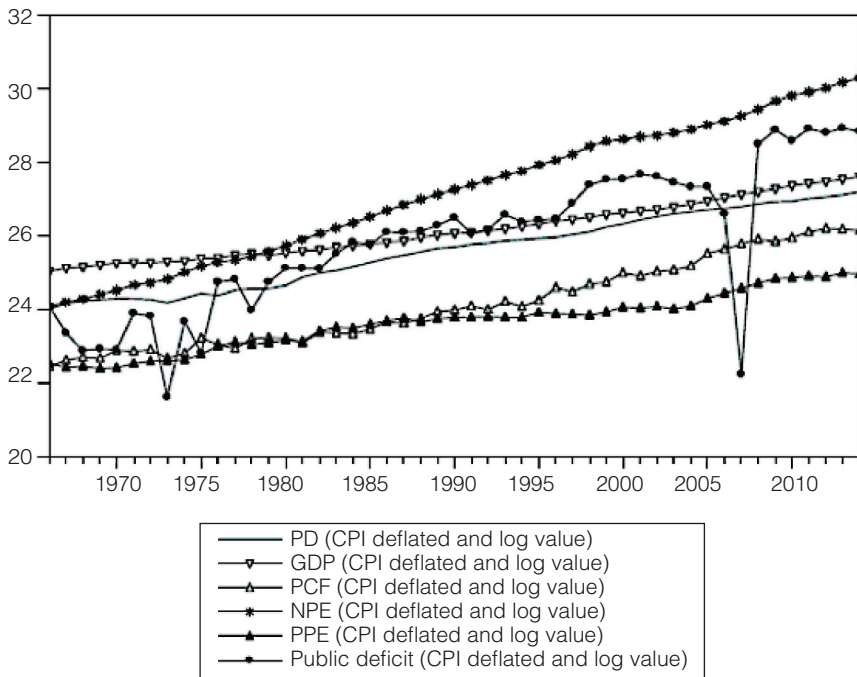


Figure 2 Time trends of log and deflated CPI variables, 1961–2014

LPPE and LNPE, LGDP and LDEF which do not exhibit breaks, but appear to be trended and to have non-normal residuals, the Schmidt–Phillips test (SP) was used. In both cases, the null hypothesis of the unit root could not be rejected at classical levels.

The results of the unit root test indicate that the cointegration among the variables can be tested. We then test for cointegration by using the Johansen–Juselius methodology, which allows for the existence of multiple cointegrating relationships. With six integrated variables, there can be at most five cointegrating relationships for the variables defined in levels.

5.2.2 Cointegration and identification tests

Our model in Section 3 involves a simple relationship between public investment (empirically $LPPE$), private investment (empirically $LPCF$), public consumption ($LNPE$), public debt (empirically LPD), gross domestic product ($LGDP$), and deficits ($LDEF$). More specifically, the economy's rate of growth (g) depends on macroeconomic conditions, proxied by the public propensity to consume (a), the productivity of public investment σ_g , the productivity of private investment σ_p , and public investment I_g . The function is increasing in all variables except a .

$$g = g(a^-, \sigma_g^+, \sigma_I^+, I_g^+) \quad (22)$$

The public-debt ratio, $b = b(d, \gamma, \sigma_g, \sigma_I, I_g)$, is stabilized only when deficits (d) are incurred because of public investment.

We estimate model (1) in a vector error correction model (VECM) setting including four variables: private-capital formation, public investment, public consumption, and public debt. The VECM can be defined, as usual, as

$$\Delta V_t = A(L)\Delta V_t + \Pi V_{t-1} + \varepsilon$$

for

$$V = [LPPE, LNPE, LPCF, LPD],$$

where L is the lag operator and ε is an error term. Π can be written as $\Pi = \alpha\beta'$, where α and β are $m \times n$ matrices (m is the number of variables in V , while n denotes the number of cointegrating relationships). β is a vector of cointegrating relationships and α is a loading matrix defining the adjustment speed of the variables in V to the long-run equilibria defined by the cointegrating relationships.

The optimal lag length was selected on the basis of the Schwarz (SC) and Hannan-Quinn (HQ) criteria and by examining the auto correlation function (ACF) and the partial auto correlation function (PACF) of the variables. Both these suggested the inclusion of one lag. More specifically, the correlogram shows that all the variables except private capital formation are AR(1). The residuals originating from the series were also independently and identically distributed (i.i.d.).

Table 2 reports the results of the Johansen trace test for correlation. The null hypothesis is of cointegrating rank of at most n . The null is rejected for $r = 0$ and $r \leq 1$, at 1 and 5 percent level of significance and it seems that there are two cointegration relationships between the variables analysed. Additionally, all characteristic roots lie inside the unit circle, and hence the system is stable and converges towards a long-run equilibrium.

The estimated unrestricted cointegrating vectors are reported in Table 3. Based on the signs of the relevant parameters, it appears that the vectors 1 and 2 can be interpreted as the cointegrating relationship. However, these are unrestricted values and can be interpreted only after the restriction tests have been performed. The long-run exclusion tests suggest that none of the variables except public consumption (LNPE) included in the VECM can be omitted from the long-run relationships.

The hypothesis of weak exogeneity cannot be rejected only for LGDP. The weak exogeneity could be due to a number of external macroeconomic factors that can affect GDP growth. However, the interesting result is that the data support the restriction of public consumption, as it seems that this variable does not contribute to the correction of public-debt disequilibrium in the long run. Since this variable does not pass the long-run exclusion test, further interpretation of the coefficients linked to the same is avoided.

Table 2 Johansen's trace test results

Null hypothesis	Eigen value	Trace statistics	5% p -value
$r = 0$	0.7140	130.4200	0.0000
$r \leq 1$	0.4610	71.5910	0.0359
$r \leq 2$	0.3784	42.5430	0.1441
$r \leq 3$	0.2142	20.1890	0.4101
$r \leq 4$	0.1716	8.8540	0.3790
$r \leq 5$	0.0001	0.0054	0.9405

Table 3 Unrestricted cointegration vectors and restriction tests

Variable name	LDEF	LGDP	LPCF	LPPE	LNPE	LPD
β_1	1.4868	-18.1500	11.2360	-0.3738	-0.0747	-1.5759
β_2	-0.6760	-14.3400	6.7578	5.5959	2.9055	-5.7545
Long-run exclusion ^a	30.6550	14.4040	19.0020	5.6589	2.1974	7.4323
	<i>0.0000</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0590</i>	<i>0.3332</i>	<i>0.0243</i>
Weak exogeneity	11.6860	2.1348	16.0140	21.9800	20.4730	6.4130
	<i>0.0020</i>	<i>0.3430</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0000</i>	<i>0.0400</i>

Note: a. The test statistics follow a chi-square distribution. *p*-values are reported directly below the coefficients in italics.

Finally, to identify the final cointegrating relationship, we imposed the following joint exclusion and exogeneity restrictions on the cointegration parameters:

$$H_0 = \beta_1 LNPE = \beta_2 LNPE = \alpha_1 LGDP = \alpha_2 LGDP = 0.$$

If the null hypothesis is not rejected, the results above concerning the weak exogeneity and long-run exclusion hold. Since the null hypothesis cannot be rejected (chi-square value = 3.664 and *p*-value 0.453), the parameters are normalized in *LPD* and are the following:

$$\text{Publicdebt} = 20.127LGDP - 9.496PCF - 4.40PPE + 0.55LDEF$$

$$\text{Publicdebt} = 17.318LGDP - 10.954PCF - 0.246PPE - 1.463LDEF.$$

These estimates show that the economy's growth rate, private investment, public investment, and public deficit are key determinants of the public debt's trajectory. It also seems that the public debt accumulation is higher when GDP is high. The sign of the relationship with GDP may not be easy to interpret given the latter's weak exogeneity. An increase in private investment seems to be inversely related to GDP. This could be interpreted as being due to the spillovers on growth that investment can create in the long run.

Public investment and deficits are negatively related to debt in one relation and the sign is positive in the other case. This result may not be easy to interpret. It is possible that a direct effect of an increase in public investment would be an increase in public debt. Nevertheless, the positive spillovers from the increase in public investment can help to increase the efficiency of private investment. This in turn can help to stabilize public debt in the long run. As proved in the theoretical model in Section 3, if this deficit is high due to an increase in public investment, the long-run effects on debt can still be stabilizing.

The cointegration and VECM model interactions can be useful to quantify the joint relationship between public investment, private investment, and growth, which in turn is useful to validate the model in Section 3 above. In other words, it could be difficult to prove that increasing deficits can have positive effects on the economy. However, if these deficits do seem to raise the productive capacity of the economy in the long run, the economy can grow at a higher rate during forthcoming years. This, in turn, can stabilize the debt-to-GDP ratio of the economy.

The result that the coefficient for long-run exclusion of public consumption (non-productive public expenditure) is not statistically significant is a useful one, as it shows that non-productive public expenditure does not seem to contribute to the mean reversion of the public-debt series. On the contrary, no such conclusions can be made about public investment. It also seems intuitive that the instantaneous relationship between public investment

and debt is inverse. The positive spillovers of public investment would not be immediately visible. Empirically, these positive spillovers can only be seen through forecasts which simulate responses between variables, as presented in the next section.

5.2.3 *The short-term dynamics*

The short-run dynamics of public debt can be assessed using the loading matrix (α) in conjunction with the normalized restricted cointegrating vectors reported in the cointegrated relationship in 5.2.2 above.

As discussed in Juselius (2006), if α and β components of the cointegrating matrix both have the same sign, then public debt would converge to equilibrium. On the other hand, if they have opposite signs, then the public debt would not converge to equilibrium. In such a case, the convergence would be achieved through movements of the other variables in the VECM.

Based on the loading matrix presented in Table 4, debt is equilibrium-correcting in deficit for both cointegrating relationships. As a result, all else being equal, short-term disequilibria in debt are self-correcting, though slowly, given the magnitude of the loading coefficient. On the other hand, movements in private-capital formation are essential in correcting the disequilibria in debt. Finally, since we have used log values all the way through, it can also be said that 6 percent of the deviation from the equilibrium is corrected through private-capital formation.

5.2.4 *Impulse responses and robustness analysis*

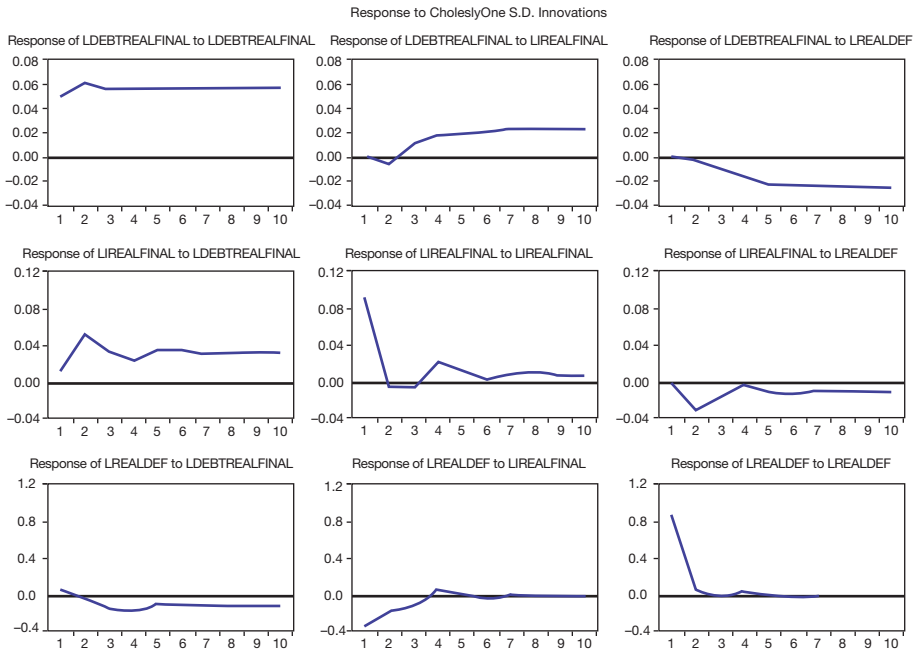
The impulse response functions are presented only for the variables whose coefficients are significant and where the loading coefficients indicate participation in equilibrium correction. It can be seen that a one-standard-deviation increase in private-capital formation increases the level of public debt (Figure 3). However, the value seems to get stabilized eventually. Similarly, a one-standard-deviation increase in deficits seems to reduce and stabilize debt in the long run. The interpretation of the same may not be straightforward as the composition of this deficit is not known.

To ensure that our model is stable, a few additional robustness checks are performed on the data. To begin with, the AR roots of the model are examined. These reveal that only $n - r$ of the roots (being the number of variables and the cointegrating relationships) are within the unit circle, which satisfies the stability condition of the VECM model. We also perform the autocorrelation LM test on the model residuals to check for serial correlation in them. However, we are not able to reject the null of no serial correlation (LM stat is

Table 4 Loading matrix

	Debt accm (α_1)	Debt accm (α_2)
ΔLPD	0.0020 (0.2817)	-0.0120 (-1.635)
ΔPCF	0.0637 (4.5869)	0.0595 (4.2454)
$\Delta LDEF$	0.5429 (3.7223)	-0.3066 (-2.0806)
$\Delta LNPE$	0.0174 (4.0507)	-0.0128 (0.0043)
$\Delta LPPE$	0.0209 (1.7331)	-0.0008 (-0.069)
$\Delta LGDP$	0 (-)	0 (-)

Note: Absolute t -statistics are in parentheses.



Notes: LDEBTREALFINAL refers to real public debt; LREALDEF refers to real deficits; and LREALFINAL refers to real capital formation. The X axis refers to the horizon after innovation.

Figure 3 Orthogonalized impulse responses of significant cointegrating relationships

34.47 while the p-value is 0.54). Finally, a test on the normality of the residuals is also performed. The Doornik–Hansen test for residual normality shows that the model residuals are normal as the null of residuals being multivariate normal cannot be rejected at the 10 percent level of significance.

The results of the unit root series show that the public-debt series follows a random walk. However, it seems that the joint relationship between public investment, private investment, and public debt shows co-movement. The result that private-capital formation is able to help the public-debt series to mean revert is important and reiterates the importance of increasing private investment in developing economies. An increase in private investment raises the productive capacity of the economy and helps to increase the rate of growth.

The additional result that private-capital formation can correct the disequilibrium in public debt only in the presence of public investment is an even more important one. This result shows that private investment is effective in stabilizing public debt in the long run only if it is complemented by public investment. In its absence, its effects are not significant. Thus, contrary to the notion of public investment ‘crowding out’ private investment, the two must work together in the long run to stabilize the public-debt trajectory.

6 CONCLUSIONS

The model presented in Section 3 shows that in the long run the economy can experience a stable ratio of public debt to GDP despite persistent government deficits. This, of

course, is true when the long-run rate of growth is larger than the interest rate on the public debt. The innovative aspect of our model is that the debt-stabilizing rate of growth is obtained thanks to adequate changes in the composition of public spending in favor of its productive component.

Our model is inspired by Domar's approach to public debt and growth. Analogous results could likely be achieved also by adopting a different sort of model; in particular one in which an increase in public spending has a positive effect on the rate of growth via its positive impact on aggregate demand and, specifically, on private investment. We believe, however, that our 'frugal' model has the advantage to require less stringent hypotheses and assumptions. In our model the higher rate of growth is obtained through a change in the composition of public spending rather than through its increase. To take into consideration the possibility that an increase in public expenditure makes the rate of growth rise while the public-debt ratio remains stable would require the adoption of a private-investment function highly sensitive to demand and dealing with the problem of the size of the fiscal multipliers. Our frugal model does not require dealing with these issues.

The results of our theoretical model are tested empirically by considering the Indian case. India, in fact, appears to be a country characterized by high rates of growth accompanied by persistent government deficits. The analysis shows that, while private-capital formation remains crucial for the economy's growth, the dynamics of the ratio of public debt to GDP can be stabilized only if public spending is devoted to public investment to a significant extent. In the absence, or lack of relevance, of public investment, the effects of private investment on the debt ratio are not significant. The two must work together in the long run to stabilize the public-debt trajectory.

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