DIPARTIMENTO DI SCIENZE SOCIALI
ED ECONOMICHE

SAPIENZA
UNIVERSITÀ DI ROMA

ISSN 2385-2755
Working papers
(Dipartimento di scienze sociali ed economiche)
[online]

WORKING PAPERS SERIES
DIPARTIMENTO DI
SCIENZE SOCIALI ED ECONOMICHE

n. 7/2016

Public Expenditure and Growth:
The Indian Case

Author/s:

A. Bhatt, C. Sardoni

SAPIENZA – UNIVERSITY OF ROME
P.le Aldo Moro n.5 – 00185 Roma T (+39) 06 49910563 F (+39) 06 49910231
CF 80209930587 - P.IVA 02133771002

PUBLIC EXPENDITURE AND GROWTH: THE INDIAN CASE

A. BHATT AND C. SARDONI

Abstract. The paper deals with the analysis of the relationship between public spending and growth as well as the dynamics of the ratio public debt/GDP. We show that a composition of public spending that favours productive expenditures, i.e. those with a direct positive effect on the economy's rate of growth, can determine a situation in which the ratio of the public debt to GDP is stable, even though the government runs primary deficits.

We test our theoretical results by considering the Indian case that, for a number of reasons, appears to be consistent with our theoretical hypotheses and assumptions. The results of the empirical analysis substantially support the idea that the dynamics of the economy as well as of the ratio public debt/GDP are crucially contingent on having a public sector that favours productive expenditures.

JEL classification: H30; H54; H60
Keywords: Public expenditure; Growth; Public debt

1. Introduction

Over the years, many researchers have dealt with the problem of the relationship between public expenditure and growth by paying growing attention to the nature and composition of public spending. Several draw a distinction between productive and unproductive public expenditures, with the first having a positive and the second a nil, if not negative, impact on the long-run rate of growth of the economy.

The discussion on public spending is naturally associated with that on its financing and, in particular, the effects on the dynamics of the the public debt and its ratio to GDP, which in turn could affect the growth path of the economy.

In this paper, after a brief survey of some of the relevant literature on these topics (section 2), we develop a simple analytical framework to study the relationship between public spending and growth as well as the dynamics of the ratio public debt/GDP (section 3). We show that an adequate composition of the public expenditure can determine a rate of growth that is compatible with a stable ratio of the public debt to GDP over time, even though the government keeps on running primary deficits. In this framework, productive public expenditures play a crucial role.

Our analytical approach is partly inspired by Domar's pioneering article on the 'burden' of the public debt (Domar 1944). In dealing with the dynamics of the public debt and its sustainability, Domar introduced the notion of productive public expenditures, that is to say those public expenditures that have a *direct* positive impact on the economy's rate of growth and, hence, can contribute to reduce or stabilise the debt ratio

Date: September 14, 2016.

University of Chicago - Harris School of Public Policy; Sapienza University of Rome, Dipartimento di Scienze Sociali ed Economiche.

which, as is well known, is contingent on the economy's rate of growth and the rate of interest on the debt.

This approach to the problem of the relation between growth and public debt differs from that mostly followed in recent years. Many, under the influence of the work of Reinhart and Rogoff (2009, 2010b), ask the question as to whether an excessively high ratio of the public debt to GDP is detrimental to the economy's rate of growth. Our paper, instead of focusing on the alleged effects of the public debt on growth, looks at the effects of public spending on the rate of growth and, consequently, on the dynamics of the ratio of the public debt to GDP.

In section 4, we test our theoretical results by considering the Indian case. 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 favours productive expenditures determines the possibility to have a stable ratio of the public debt 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 affect 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 counterpart.

Third, the testing of our model requires an empirical case where public investment is a substantive 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.

The results of our empirical analysis show that, although private capital formation remains crucial for the economy's growth, the dynamics of the ratio public debt/GDP can be stabilised only if public spending is devoted to public investment (productive expenditures) to a significant extent. In the absence, or little relevance, of public investment, the effects of private investment on the debt ratio are not significant.

2. A survey of the literature

The evolution of the debate on the nature of the public expenditure has brought with it a wide production of theoretical literature on the government optimal size, the public expenditure stance during booms, the financing of public expenditure and the political economy of public expenditure.

Wagner's law stated that there is a positive link between the size of governments and economic growth. The Peacock-Wiseman Hypothesis further contextualised Wagner's law by proposing that a periodical sharp increase in the size of the public sector resulting from upheavals can help in boosting economic growth. Such positions have been criticised by those who argue that an expansion of the government's spending beyond the size of its revenues would have to be financed by monetising the deficits, which would eventually lead to inflation. For others, the risks of an excessive increase in the supply of money

can be avoided by financing the deficits through debt creation, but the possibility to have rising ratio of the public debt to GDP causes concern about the sustainability of such situations.

More in general, the debate on the relationship between government expenditure, deficits, public debt and growth revolves around three main theoretical perspectives: the Neoclassical, Keynesian and 'Ricardian' approaches (Rangarajan and Srivastava 2005). In the neoclassical view, fiscal deficits are considered detrimental to investment and growth; in the Keynesian paradigm they are needed for providing stimulus to the economy in the short run; in a 'Ricardian' context, expansions of public spending or reductions of taxes do not have any long-run effect on the rate of growth because of the so-called Ricardian equivalence, or Barro theorem (Seater 1993). The neoclassical and Ricardian schools focus on the long run while the Keynesian view emphasises the short-run effects of public expenditure.

More specifically, in the Keynesian model, an increase in debt stimulates the economy in the short-run by making households feel wealthier. On the other hand, public debt competes with private debt for available funds, which drives up interest rates and changes the composition of output, crowding out private investment with deleterious effects on long-term growth.

The Ricardian equivalence, on the other hand, states that debt implies future taxes with a present value equal to the value of the debt. If agents are rational, they will recognise this equivalence and proceed as if debt did not exist. In the end, debt has no effects on economic activity. This, however, is subject to the intensity of intergenerational altruism, possibilities of strategic behaviour being maintained, liquidity constraints and constraints related to household maximisation decision (Seater 1993).

In the context of these discussions, also the problem of the composition of public spending has been considered. Adding to the body of theoretical literature on public expenditure and growth, Devarajan et al. (1996) made a seminal contribution. Their paper established a direct relationship between productive components of public expenditure and growth, that is to say those expenditures that alter the economy's long-term growth rate. In a dynamic optimisation framework, they demonstrate that until the level of optimal productive expenditure is reached, it is worthwhile to increase them. Agénor and Neanidis (2006) explore a similar framework. They analyse the possible optimal allocation of public spending among health, education and infrastructure, taking into account the dynamics between these sectors.

Glomm and Ravikumar (1997) review the relationship between productive public expenditure and growth by using endogenous growth models as proposed by Arrow and Kurz (1970), Barro and Sala-i-Martin, X. (1990), Glomm and Ravikumar (1994). They disaggregate total expenditures into those that enter as inputs in the production function (infrastructure) and those that enter as inputs in investment technologies such as expenditures on education, even though they conclude that this distinction may be insufficient to analyse the link between public expenditure and growth. In fact, endogenous growth models may not be able to factor in the treatment of expenditures, such as those on health, that may have a one-time impact in the long-run.

Arrow and Kurz (1970) developed a model where consumers derive utility from private consumption as well as from the public capital stock. Barro and Sala-i-Martin, X.

(1990), Barro (1991) introduce government expenditure and classify public spending as consumption and investment expenditure. However, in Barro's models public spending only affects the economy's transitional growth rate, while the steady-state growth rate remains unaltered. The empirical findings suggest that non-productive expenditures can have a long-term negative effect on the growth rate of real GDP per capita, leading to higher ratios of the public debt to GDP.

Turnovsky and Fisher (1995) adopt an inter-temporal optimising market-clearing framework to analyse the effect on macroeconomic performance of government consumption and infrastructure expenditures respectively. They disaggregate the effect of a change in the composition of public expenditure into a resource withdrawal effect and a private decisions effect. The first effect is directly proportional to the increase in consumption expenditure as this expenditure is not as research augmenting as infrastructure expenditure. The second effect, in turn, may vary contextually. For instance, if infrastructure expenditures positively impact on the marginal physical products of the private factors of production (capital and labour), the overall impact of the increase in infrastructure spending may be positive.

Empirical studies on public expenditure and growth have analysed the impact of public expenditure on growth directly and indirectly (via an increase in productivity fostered by increase in public investment). For instance, for the USA Aschauer (1989), Munnell (1990), and da Silva Costa et al. (1987) find a significant impact of the public capital stock on private sector productivity.[1] Later studies, such as Evans and Karras (1993), Tatom (1991), Sturm and De Haan (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.

After 1997, the research on public expenditure and growth has become more focused on the relationship between public spending and growth via investment, by also discussing whether the effect of investment is instantaneous or lagged.[2] Minea and Villieu (2013) look at the long-run growth effect of borrowing for public investment in the light of the model developed by Futagami et al. (2008).[3]

Empirical analyses of the relationship between public expenditure and growth via investment include Carranza et al. (2014) who look at the relationship between fiscal consolidation and public investment in six of the main Latin American economies (Argentina, Brazil, Chile, Colombia, Mexico, and Peru). They find that simple austerity measures that focus on cuts in current expenditures may not be appropriate for fiscal consolidation. They point to the case of Peru where fiscal imbalances were reduced by

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

[2]But the debate on this aspect began earlier, when the so-called 'big-push models' as presented in Rostow (1960), Rosenstein-Rodan (1961), Murphy et al. (1989) were introduced. These models put forward the idea that the infrastructure gap in developing countries can be closed only through an increase in public spending. However, there may also be a perverse selection effect by means of which there may be a selection of relatively poor public investment projects, which may lead to diminishing returns to additional capital.

[3]They consider the question whether a debt policy rule should be based on looking at the ratio of the debt to GDP or at its ratio to private capital and conclude that the rule based on the ratio public debt/GDP is easier to implement, as the private capital stock may be difficult to measure.

means of measures that favoured public infrastructure investment and placed ceilings only to current expenditures. Gupta et al. (2014) look at the effect of public investment on capital accumulation and growth. Based on an empirical analysis performed on a panel of low-income economies, they find that the quality of public investment is statistically significant in explaining variations in economic growth.

On the contrary, Warner (2014), by using a sample of 124 lower and middle income countries, shows that in most cases (with the exceptions of Ethiopia and Uganda) there is a low and instantaneous association between public investment booms and economic growth. Public investment is analysed by considering its ratio to the aggregate output and by separating its direct impact on the productivity of public capital from its productivity enhancement through stimulation. The effects of public investment are evaluated only in the years in which it produced lagged effects on growth.

The idea that there exists an optimal share of 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). Canning and Pedroni (2008) show that some developing countries have over-invested in infrastructures, which does not contribute to the increasing of their rate of growth. Warner (2014) also finds a negative relationship between public investment booms and private investment rates and concludes that public investment crowds private capital formation out. But others support the idea that public investment can have a crowd-in effect. Cavallo and 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. In countries where openness to trade and financial flows are high and public institutions are good, there exists a complementarity between public and private investment. Khan and Kumar (1997) argue that some components of public expenditure may be complementary with private investment. For instance, public investment in infrastructure and human capital formation can increase the productivity of private capital.[4]

The theoretical work of Chatterjee and Turnovsky (2005, 2007) is also an important contribution as they use an open economy model to analyse the effect of financing public investment through foreign aid. Their results show that an important determinant of the impact on growth is linked to whether foreign aid is used for investment purposes or not. In their recent work, Christie and Rioja (2012) are able to demonstrate that fiscal conditions of the economy are a key determinant of the optimal strategy to finance public investment. Thus, lending support to the fact that public investment must be increased only until its optimal point is reached.[5] Teles and Mussolini (2014) using an overlapping generations model show that the marginal effect on growth of productive expenditures (infrastructure, education, health) depends on the government's primary surplus and size of the debt.

[4]Earlier literature, such as Pradhan et al. (1990), finds that public investment crowds private investment out but also that the overall effect of public investment on total investment, growth and income distribution offsets this crowding-out effect.

[5]The optimal point can be reached at different times by different countries, depending on their level of economic advancement and other fiscal conditions.

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.

The empirical literature on economic growth and debt has produced different results depending on the kind of economies analysed (developing vs. advanced). Ortiz and Cummins (2013) analyse the IMF government spending projections for 181 countries by comparing the four distinct periods of 2005-07 (pre-crisis), 2008-09 (crisis phase I: fiscal expansion), 2010-12 (crisis phase II: onset of fiscal contraction) and 2013-15 (crisis phase III: intensification of fiscal contraction) in the light of the main adjustment measures used by these countries According to them, a disaggregated analysis of the different types of infrastructure is able to play a significant role in explaining the trade-offs between public deficits and the reduction of infrastructure gaps.

Seccareccia (2012) discusses the modern 'financial balances' view of fiscal policy and argues in favour of a return to Keynes's view of long-term fiscal policy, which emphasises the role of public investment as a tool to promote long-term growth. He replicates the technique used by Reinhart and Rogoff (2010b,a) to analyse the effects of high public debt/GDP ratios on growth. Using a dataset of advanced economies, he finds that a high public debt/GDP ratio does not necessarily reduce a country's GDP growth.

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 80s. 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.

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 current expenditures cuts are, in general, more conducive to growth. Higher current expenditures and domestic financing of deficit are associated with less favourable economic performance. Empirical literature with similar results includes Landau (1983) and Summers et al. (1984).

Checherita-Westphal and Rother (2012) argue that the relationship between growth and debt is non-linear at least in the case of EU (12) since 1970. The channels through which this impact is observed are private saving, public investment and total factor productivity. Panizza and 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 while analysing the data for the same set of countries for a similar period of time, even if a negative correlation exists.

Baumol (1967) coined the term 'Cost Disease' and argued that the productivity of government services may be highly influenced by the lack of incentive for bureaucrats to introduce processes and product innovations in the delivery of public services. Peacock (1969) supported this argument and divided the economy into progressive (manufacturing amongst others) and non-progressive sectors (education, health amongst other)

respectively. This distinction helped in understanding the lack of scope for technological innovation and productivity increases in the non-progressive sector.

This lack of scope for innovation means that non-progressive sectors expand in a labour-intensive set up and increasing labour costs are not offset by technological innovations. Thus, technologically stagnant sectors experience more than average rises in cost and prices and declining real outputs (Nordhaus, 2006).

The political economy of public expenditure is important when the effectiveness of public investment and its relationship with growth and debt is analysed. Warner (2014) identifies a number of problems in the public sector design which can create impediments to the practical success of public investment. The first is linked to incentives for key actors which exceeds the social value of the investment. Other reasons include over-optimistic forecasts, non-existent economic analysis and use of public enterprises as vehicles for conducting investment projects. Schuck (2014) offers a thorough explanation of many failures of federal policies in the US and the consequent growing public dissatisfaction with state intervention. Del Monte and Papagni (2001), using the case of Italy, show that the productivity of public expenditure is substantially impacted by corruption.

3. Productive public spending and growth: an analytical framework

In this section we put forward an analytical framework to study the relationship between public spending, growth and the long-run dynamics of the ratio of public debt to GDP. We concentrate on the distinction between productive and unproductive public expenditures and their different impact on the economy's rate of growth and the dynamics of the public debt ratio.

Our analytical construct is 'frugal', in the sense that we essentially concentrate on the analysis of the long-period equilibrium conditions for a closed economy with a public sector that spends on goods and services and levies taxes. No particular hypotheses are made about the investors' and consumers' behaviour.

Our main conclusion is that, as a consequence of an adequate amount of public resources being devoted to productive expenditures, the economy can realise a growth path characterised by a stable, or declining, public debt ratio, even though the government keeps on running primary deficits.

3.1. **Productive and unproductive public expenditures.**

Let us start by providing the definition of productive and unproductive public expenditures that we use in the present context.

> **Productive expenditures:** all those government expenditures that *directly* affect the economy's long-run growth rate by determining an increase in the rate of capital accumulation, which is interpreted as inclusive of both physical and human capital.
>
> Public productive expenditures have an impact on the rate of capital accumulation either directly or through their effect on private investment. Capital productive expenditures evidently contribute directly to the growth of the economy's productive capacity; but, more in general, productive expenditures can affect the

productive capacity by favouring a larger amount of private investment and its efficiency, like for example it is the case of investment in infrastructures.[6]

Unproductive expenditures: they are all those government expenditures that do not produce direct effects on capital accumulation and growth.[7]

3.2. **Productive public spending and the equilibrium rate of growth.** 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.[8]

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

$$\frac{dy}{dt} = Y' = \frac{dY}{dt} = \frac{dP}{dt} = P' = \frac{dP}{dt} \tag{1}$$

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

$$\sigma = \frac{\frac{dP}{dt}}{I} = \frac{P'}{I} \tag{2}$$

i.e.

$$P' = \sigma I$$

Let us now introduce public spending by distinguishing between productive public expenditure (or public investment), I_g, and unproductive public expenditure (or 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, i.e.

$$C_g = atY$$

and

$$C'_g = atY'$$

[6]For simplicity, we often denote productive public expenditures as public investment and unproductive expenditures as current public expenditures. But Domar was 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 satisfy these requirements. The same holds true for expenditures on education, research, flood control, resource development and so on.' (Domar 1944, p. 820).

[7]Such expenditures, however, can affect accumulation and growth *indirectly*. If private investment depends on aggregate demand, an increase in unproductive public spending affects private investment indirectly through its impact on aggregate demand.

[8]This section is largely based on Sardoni and Palazzi (2000).

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, i.e.

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

so that

$$P' = \sigma(I_g + I_p) \tag{3}$$

It is easy to see that the equilibrium condition (1) now transforms into

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

(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

$$g = [(1-t)s + t(1-a)]\sigma \tag{5}$$

g is obviously 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.

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

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

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 also clear that, given s and t, the equilibrium rate of growth reaches its maximum when $a = 0$, i.e. 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, irrespectively of their economic impact.[9] Therefore, we impose that

$$0 < \bar{a} \leq a < 1 \tag{7}$$

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

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

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

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

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

[9]We can define these unproductive expenditures as necessary. Obvious examples are public spending on defence, public order, etc.

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

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

So far, we have assumed that the productivity of public and private investment is the same. Now we remove this hypothesis and assume that $\sigma_g \neq \sigma_p$ and, for now, we also assume that the productivity of private investment is independent of productive public expenditure.

Under the hypothesis that $\sigma_g \neq \sigma_p$, the average total investment productivity is

$$\sigma = \frac{I_p\sigma_p + I_g\sigma_g}{I_p + I_g} \tag{10}$$

i.e. 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.[10] 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

$$\bar{\sigma} = \frac{I_p\sigma_p + \bar{I}_g\sigma_g}{I_p + \bar{I}_g} \tag{11}$$

If we lift 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

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

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

$$\bar{\bar{\sigma}} = \frac{h\sqrt{\bar{I}_g}I_p + \bar{I}_g\sigma_g}{\bar{I}g + I_p} \tag{13}$$

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

$$\bar{\bar{g}} = [(1-t)s + t(1-\bar{a})]\bar{\bar{\sigma}} = \chi\bar{\bar{\sigma}} \tag{14}$$

with $\chi = [(1-t)s + t(1-\bar{a})]$.

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

3.3. **Introducing deficits and public debt.** So far, we have assumed a balanced public budget and no public debt. We now lift these assumptions and 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 the 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

$$\gamma_1 + \gamma_2 + rb - \tau = d\tau \tag{15}$$

where d is a scalar larger than 1.[11]

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,

$$\gamma_2 = a\tau$$

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

$$\gamma_1 = (d - a)\tau - rb \tag{16}$$

The maximum value of γ_1 is

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

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

If also the hypothesis that the productivity of private investment is increase in the productive public expenditures is maintained, 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

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

Consequently, the economy's rate of growth is maximum when[12]

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

An economy in which the government is running a primary deficit necessarily experiences a growing public debt.[13] Such a situation can be considered as sustainable if the ratio of the public debt to GDP (b) is constant over time. As 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.[14]

[11]Obviously, if $d = 1$, the budget is in balance and, if $d < 1$ the government is running a surplus.

[12]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 $\chi_b \neq \chi$.

[13]For simplicity, we assume that there is no monetisation of the debt.

[14]For any $\bar{g} > r$ and $b > 1$, the ratio b of the public debt to GDP converges to $\bar{b} = \frac{\gamma - \tau}{\bar{g} - r}$.

Therefore, to obtain a stable ratio of the public debt to GDP, it is necessary to introduce a further constraint on $\bar{g}_b$, that is to say,

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

which is satisfied for

$$d > \bar{a} + \frac{r\left(b + \frac{r}{m^2\chi^2}\right)}{\tau} \tag{21}$$

A constant ratio of the public debt to Y can be realised despite a persistent government's deficit, only if this deficit, expressed by the value taken by d, is sufficiently large.

Such an apparently counterintuitive result depends on the fact that the deficit, net of the share devoted to the financing of necessary unproductive expenditures ($\bar{a}\tau$), 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.

4. 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 the previous section 3.

4.1. **A survey of the literature on India.**

By considering the case of India, Rangarajan and Srivastava (2005) show that the overall growth rate is dependent on the overall saving and investment rates. Thus, in the past, when government saving falls, 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, the public investment as a ratio of debt-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 with 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.

Asher (2012) reiterates the IMF style method to check for debt sustainability, according to which the Indian debt/GDP ratio will fall from 64.1% in 2010 to 61.2 % in 2016. The most part 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 and 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 stabilising manner to the increase in debt. They also are concerned about persistent primary deficits.

Buiter and Patel (2006), using the stationarity tests developed by Phillips and 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 and 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 the public debt as in the same manner as Buiter and Patel (2006) by employing the cointegration test developed by Gregory and 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.

Also other works, like Parker and Kastner (1993), Cashin et al. (1998), Cashin and Olekalns (2000), Callen and Cashin (2001), Reynolds (2001), Lahiri and Kannan (2002), Rangarajan and Srivastava (2005), Mohan et al. (2005), Buiter and 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.

4.2. **An empirical analysis.** We estimate a 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 public debt/GDP can be stabilised in the long-run if most of the new public spending is on productive components. Private investment and public investment react sluggishly to the public debt, but they seem to correct the debt disequilibrium in the long run.

4.2.1. *Data and unit roots.* Annual data available from the Reserve Bank of India are used for the period spanning from 1961 to 2014. The productive component of public expenditure series is available from the Handbook of Statistics on the Indian economy (gross capital formation by 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 Rs) is used. We follow the literature (Devarajan et al. 1996) and the theoretical model in Section 3 to define the productive component of the public expenditure and the private capital formation.

Productive expenditure by the government is said to include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; 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 below.

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

Table 1. Descriptive Statistics, 1961 - 2014

Variable Name	**Mean**	**St. Dev**	**Min**	**Max**
Public Debt (Ratio to GDP)a	59.24	15.79	32.69	83.23
Gross fiscal deficit (Ratio to GDP)b	7.55	1.37	4	9.6
Gross Primary deficit (Ratio to GDP)a	2.91	1.89	-1.2	8.1
Consumption (Ratio of GDP)a	66.65	6.35	55.69	78.11
Private capital formation (Ratio of GDP)a	14.5	6.38	7.25	27.91
Productive Public expenditure (Ratio of GDP)a	8.34	1.6	5.8	12.23
Non productive public expenditure (Ratio to GDP)a	10.85	1.11	8.53	12.79
a: percent values; b: 1981: 2014				

a declining trajectory. However, in the early 2000s, the debt rose sharply to around 80 per cent of GDP and has started stagnating after the global financial crisis in 2008.

The productive (PPE) and non-productive expenditure (NPE) seem to be moving in conjunction with each other starting from the early 1990s. However, the NPE has been consistently higher (as a ratio to GDP) in the post-liberalisation 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 ($LGDP$), 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. 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-Andrew test, which allows for one endogenous break, was used (Zivot and 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 Fiscal Responsibility and Budget Management Act (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 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 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.

4.2.2. *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.

$$g = g(a^-, \sigma_g^+, \sigma_I^+, I_g^+) \tag{22}$$

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

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

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

for

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

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 mn matrices, and 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 ACF and the PACF functions 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 iid

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 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 per cent 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 vector 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.

Finally, 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 the GDP growth. However, the interesting result is that data support the restriction of public consumption as it seems that this variable does not contribute to the correction of the 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 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
	0.0000	0.0000	0.0000	0.0590	0.3332	0.0243
Weak exogeneity	11.6860	2.1348	16.0140	21.9800	20.4730	6.4130
	0.0020	0.3430	0.0000	0.0000	0.0000	0.0400

(a) The test statistics follow a chi-square distribution. p-values reported in brackets.

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

$$H0 : \beta_1 LNPE = \beta_2 LNPE = \alpha_1 LGDP = \alpha_2 LGDP = 0.$$

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 normalised in LPD and are the following:

$$\text{Public debt} = 20.127 LGDP - 9.496 PCF - 4.40 PPE + 0.55 LDEF$$
$$\text{Public debt} = 17.318 LGDP - 10.954 PCF + 0.246 PPE - 1.463 LDEF$$

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 its weak exogeneity. An increase in private investment seems to be inversely related to GDP. This could be interpreted as 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 could be 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 increasing the efficiency of private investment. This in turn can help stabilising the 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 stabilising.

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 in the forthcoming years. This, in turn, can stabilise 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 perfectly intuitive that the instantaneous relationship between public investment and debt is inverse. As emphasised in section 3, 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.

4.2.3. *The short-term dynamics.* The short-run dynamics of public debt can be assessed using the loading matrix (α) in conjunction with the normalised restricted cointegrating vectors reported in the cointegrated relationship in section 4.2.

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

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 (-)
Absolute t-statistics in parenthesis		

Based on the loading matrix presented in Table 4, debt is equilibrium-correcting in deficit for both cointegrating relationships. As a result, all else 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 through, it can also be said that six per cent of the deviation from the equilibrium is corrected through private capital formation.

4.2.4. *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, increase the level of public debt. However, the value seems to get stabilised eventually. Similarly, a one standard deviation increase in deficits seems to reduce and stabilise 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 (n being the number of variables and r 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 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 per cent 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 increasing 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 stabilising 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 stabilise the public debt trajectory.

5. Conclusions

By using a simple analytical framework, we have established a functional relation between the composition of public spending and the behaviour of the ratio of public debt to GDP. Our main conclusion is that an economy, in the long run, can experience a stable ratio of the public debt to GDP despite persistent government primary deficits. In

this context, the distinction between productive and unproductive public expenditures is crucial. We show that a stable debt ratio is compatible with primary deficits if the latter are mainly devoted to financing productive expenditures that have a positive impact on the rate of growth as well as on private investment.

We test our analytical results empirically by considering the Indian case. India, in fact, appears to be a country characterised by high rates of growth accompanied by persistent government deficits. Our empirical analysis shows that, while private capital formation remains crucial for the economy's growth, the dynamics of the ratio public debt/GDP can be stabilised only if public spending is devoted to public investment to a significant extent. In the absence, or little relevance, of public investment, the effects of private investment on the debt ratio 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 stabilise the public debt trajectory.

References

Agénor, P. R. and Neanidis, K. N. . W. P.: 2006, The allocation of public expenditure and economic growth, *The School of Economics Discussion Paper Series 0608*, University of Manchester, Manchester.

Arrow, K. J. and Kurz, M.: 1970, Optimal growth with irreversible investment in a Ramsey model, *Econometrica* **38**(2), 331–344.

Aschauer, D. A.: 1989, Is public expenditure productive?, *Journal of monetary economics* **23**(2), 177–200.

Asher, M. G. .: 2012, Public debt sustainability and fiscal management in india, *in* B. Ferrarini, J. Raghbendra and A. Ramayandi (eds), *Public Debt Sustainability in Developing Asia*, Routledge, London and New York, pp. 139–169.

Barro, R. J.: 1991, A cross-country study of growth, saving, and government, *in* B. D. Bernheim and J. B. Shoven (eds), *National Saving and Economic Performance*, University of Chicago Press, Chicago, chapter 9, pp. 271–304.

Barro, R. J. and Sala-i-Martin, X.: 1990, Public finance in models of economic growth, *Working Paper 3362*, NBER, Cambridge Ma.

Baumol, W. J.: 1967, Macroeconomics of unbalanced growth: The anatomy of urban crisis, *American Economic Review* **57**(3), 415–426.

Bose, N., Haque, M. E. and Osborn, D. R. .: 2007, Public expenditure and economic growth: A disaggregated analysis for developing countries, *The Manchester School* **75**(5), 533–556.

Buiter, W. H.: 1998, The young person's guide to neutrality, price level indeterminacy, interest rate pegs, and fiscal theories of the price level, *Working Paper 6396*, National Bureau of Economic Research., Cambridge Ma.

Buiter, W. H. and Patel, U. R.: 2006, Excessive budget deficits, a government-abused financial system, and fiscal rules, *in* S. Bery, B. Bosworth and A. Panagariya (eds), *India Policy Forum 2005/2006*, SAGE, New Delhi, pp. 1–54.

Callen, T. and Cashin, M. P.: 2001, Assessing India's external position, *in* T. Callen, P. Reynolds and T. C. (eds), *India at the Crossroads: Sustaining Growth and Reducing Poverty*, IMF, Washington.

Canning, D. and Pedroni, P.: 2008, Infrastructure, longrun economic growth and causality tests for cointegrated panels, *The Manchester School* **76**(5), 504–527.

Carranza, L., Daude, C. and Melguizo, A.: 2014, Public infrastructure investment and fiscal sustainability in latin america: Incompatible goals?, *Journal of Economic Studies* **41**(1), 29–50.

Cashin, M. P., Olekalns, N. and Sahay, M. R.: 1998, Tax smoothing in a financially repressed economy: evidence from India, *Working Paper 98/122*, IMF, Washington.

Cashin, P. and Olekalns, N.: 2000, An examination of the sustainability of Indian fiscal policy, *Department of Economics - Working Papers Series 748*, University of Melbourne, Melbourne.

Cavallo, E. and Daude, C.: 2011, Public investment in developing countries: A blessing or a curse?, *Journal of Comparative Economics* **39**(1), 65–81.

Chatterjee, S. and Turnovsky, S. J. .: 2007, Foreign aid and economic growth: The role of flexible labor supply, *Journal of Development Economics* **84**(1), 507–533.

Chatterjee, S. and Turnovsky, S. J.: 2005, Financing public investment through foreign aid: consequences for economic growth and welfare, *Review of International Economics* **13**(1), 20–44.

Checherita-Westphal, C. and Rother, P.: 2012, The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area, *European Economic Review* **56**(7), 1392–1405.

Christie, T. A. L. and Rioja, F. K.: 2012, Debt and taxes: Financing productive government expenditures. Job Market Paper.

da Silva Costa, J., Ellson, R. W. and Martin, R. C.: 1987, Public capital, regional output, and development: Some empirical evidence, *Journal of Regional Science* **27**(3), 419–437.

Del Monte, A. and Papagni, E.: 2001, Public expenditure, corruption, and economic growth: the case of Italy, *European Journal of Political Economy* **1**, 1–16.

Devarajan, S., Swaroop, V. and Zou, H. F.: 1996, The composition of public expenditure and economic growth, *Journal of monetary economics* **37**(2), 313–344.

Domar, E. D.: 1944, The 'burden of the debt' and the national income, *American Economic Review* **34**(4), 798–827.

Elliot, G., Rothenberg, T. J. and Stock, J. H.: 1996, Efficient tests for an autoregressive unit root, *Econometrica* **64**(4), 813–36.

Evans, P. and Karras, G.: 1993, Do standards of living converge?: Some cross-country evidence, *Economics Letters* **43**(2), 149–155.

Futagami, K., Iwaisako, T. and Ohdoi, R.: 2008, Debt policy rule, productive government spending, and multiple growth paths, *Macroeconomic Dynamics* **12**(4), 445–462.

Glomm, G. and Ravikumar, B.: 1994, Public investment in infrastructure in a simple growth model, *Journal of Economic Dynamics and Control* **18**(6), 1173–1187.

Glomm, G. and Ravikumar, B.: 1997, Productive government expenditures and long-run growth, *Journal of Economic Dynamics and Control* **21**(1), 183–204.

Goyal, R., Khundrakpam, J. K. and Ray, P.: 2004, Is India's public finance unsustainable? or, are the claims exaggerated?, *Journal of Policy Modeling* **26**(3), 401–420.

Gregory, A. W. and Hansen, B. E.: 1996, Practitioners corner: tests for cointegration in models with regime and trend shifts, *Oxford bulletin of Economics and Statistics*

58(3), 555–560.

Greiner, A.: 2012, Public debt in a basic endogenous growth model, *Economic Modelling* **29**(4), 1344–1348.

Gupta, S., Clements, B., Baldacci, E. and Mulas-Granados, C.: 2005, Fiscal policy, expenditure composition, and growth in low-income countries, *Journal of International Money and Finance* **24**(3), 441–463.

Gupta, S., Kangur, A., Papageorgiou, C. and Wane, A.: 2014, Efficiency-adjusted public capital and growth, *World Development* **57**, 164–178.

Herndon, T., Ash, M. and Pollin, R.: 2014, Does high public debt consistently stifle economic growth? a critique of Reinhart and Rogoff, *Cambridge journal of economics* **38**(2), 257–279.

Jha, R. and Sharma, A.: 2004, Structural breaks, unit roots, and cointegration: A further test of the sustainability of the Indian fiscal deficit, *Public Finance Review* **32**(2), 196–219.

Juselius, K.: 2006, *The Cointegrated VAR Model*, Oxford University Press, New York.

Kaur, B. and Mukherjee, A.: 2012, Threshold level of debt and public debt sustainability: The indian experience, *Occasional Paper Vol. 33, nos. 1-2*, Reserve Bank of India, New Delhi.

Khan, M. S. and Kumar, M. S.: 1997, Public and private investment and the growth process in developing countries, *Oxford Bulletin of Economics and Statistics* **59**(1), 69–88.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P. and Shin, Y.: 1992, Testing the null hypothesis of stationarity against the alternative of a unit root, *Journal of Econometrics* **54**(1-3), 159–178.

Lahiri, A. K. and Kannan, R.: 2002, India's fiscal deficits and their sustainability in perspective, *Nipfp working paper*, National Institute of Public Finance and Policy, New Delhi.

Landau, D.: 1983, Government expenditure and economic growth: a cross-country study, *Southern Economic Journal* **49**(3), 783–792.

Minea, A. and Villieu, P.: 2013, Debt policy rule, productive government spending, and multiple growth paths: A note, *Macroeconomic Dynamics* **17**(4), 947–954.

Mohan, R., Dholakia, R. and Karan, N.: 2005, Is India's central debt sustainable? revisiting an old debate, *Economic and Political Weekly* **40**(10), 951–59.

Munnell, A. (ed.): 1990, *Is There a Shortfall in Public Capital Investment?*, Vol. 34, Federal Reserve Bank of Boston, Boston.

Murphy, K. M., Shleifer, A. and Vishny, R. W.: 1989, Building blocks of market clearing business cycle models, *NBER Macroeconomics Annual*, Vol. 4, MIT Press, Cambridge Ma., pp. 247–302.

Ortiz, I. and Cummins, M. .: 2013, The age of austerity: a review of public expenditures and adjustment measures in 181 countries, *Working paper*, Initiative for Policy Dialogue, New York.

Panizza, U. and Presbitero, A. F.: 2014, Public debt and economic growth: Is there a causal effect?, *Journal of Macroeconomics* **41**, 21–41.

Parker, K. and Kastner, S.: 1993, *A framework for assessing fiscal sustainability and external viability, with an application to India*, IMF, Washington.

Peacock, A. T.: 1969, Welfare economics and public subsidies to the arts, *The Manchester School of Economic & Social Studies* **37**(4), 323–35.

Phillips, P. C. and Perron, P.: 1988, Testing for a unit root in time series regression., *Biometrika* **75**(2), 335–346.

Pradhan, B. K., Ratha, D. K. and Sarma, A.: 1990, Complementarity between public and private investment in india, *Journal of Development Economics* **33**(1), 101–116.

Rangarajan, C. and Srivastava, D. K.: 2005, Fiscal deficits and government debt: implications for growth and stabilisation, *Economic and Political Weekly* **40**(27), 2919–2934.

Reinhart, C. M. and Rogoff, K. S.: 2009, *This time is different. Eight centuries of financial folly*, Princeton University Press, Princeton, N.J.

Reinhart, C. M. and Rogoff, K. S.: 2010a, Debt and growth revisited, *Working Paper 24376*, MPRA, Munich.

Reinhart, C. M. and Rogoff, K. S.: 2010b, Growth in a time of debt, *American Economic Review* **100**(2), 573–578.

Reynolds, P.: 2001, Fiscal adjustments and growth prospects in India, *in* T. Callen, P. Reynolds and T. C. (eds), *India at the Crossroads: Sustaining Growth and Reducing Poverty*, IMF, Washington.

Rosenstein-Rodan, P. N.: 1961, International aid for underdeveloped countries, *Review of Economics and Statistics* **43**(2), 107–138.

Rostow, W. W.: 1960, *The process of economic growth*, Clarendon Press, Oxford.

Sardoni, C. and Palazzi, P.: 2000, Public investment and growth, *in* H. Bougrine (ed.), *The Economics of Public Spending*, Cheltenham: Edward Elgar, pp. 150–67.

Schuck, P. H.: 2014, *Why Government Fails so Often*, Princeton University Press, Princeton and Oxford.

Seater, J. J.: 1993, Ricardian equivalence, *Journal of Economic Literature* **31**(1), 142–190.

Seccareccia, M.: 2012, The role of public investment as principal macroeconomic tool to promote long-term growth, *International Journal of Political Economy* **40**(4), 62–82.

Sturm, J. E. and De Haan, J.: 1995, Is public expenditure really productive?: New evidence for the USA and The Netherlands, *Economic Modelling* **12**(1), 60–72.

Summers, R., Kravis, I. B. and Heston, A.: 1984, Changes in the world income distribution, *Journal of Policy Modeling* **6**(2), 237–269.

Tatom, J. A.: 1991, Should government spending on capital goods be raised?, *Federal Reserve Bank of St. Louis Review* **73**(3), 3–15.

Teles, V. K. and Mussolini, C. C.: 2014, Public debt and the limits of fiscal policy to increase economic growth, *European Economic Review* **66**, 1–15.

Turnovsky, S. J. and Fisher, W. H.: 1995, The composition of government expenditure and its consequences for macroeconomic performance, *Journal of Economic Dynamics and Control* **19**(4), 747–786.

Warner, A. M.: 2014, Public investment as an engine of growth, *Working Paper 14/148*, IMF, Washington.

Zivot, E. and Andrews, K.: 1992, Further evidence on the great crash, the oil price shock, and the unit root hypothesis, *Journal of Business and Economic Statistics* **10**(10), 251–70.

Figure 1: Time trends of key ratios to GDP variables (1961 -2014)

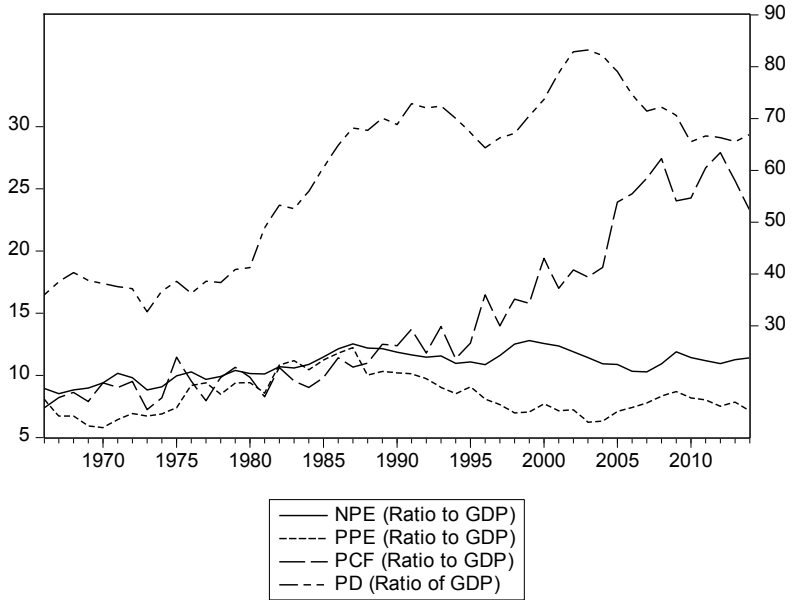

Figure 2: Time trends of log and deflated CPI variables (1961 -2014)

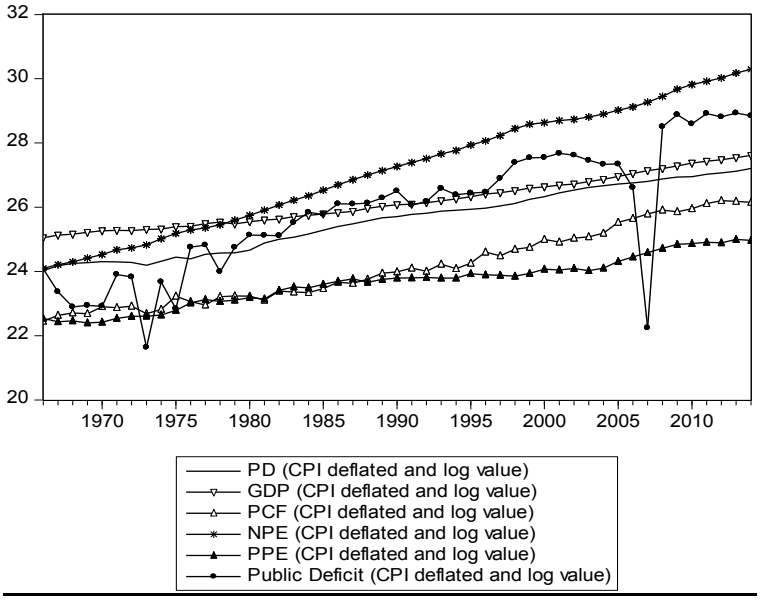

Figure 3: Impulse Responses of significant cointegrating relationships