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INVESTMENT LED GROWTH IN INDIA: FACT OR MYTHOLOGY?

Dr. Satyabrata Mishra
Associate Professor and HOD P.G. Department of Environmental Economics, M.P.C. (A) College, Odisha.

Introduction

India's investment rate has increased fourfold since 1950 and has risen sharply this decade to 35% of its gross domestic product. Nevertheless, contradictory views have been expressed regarding the importance of this investment pattern for India's economic growth. This paper evaluates the impact of the rise in India's investment rate on its economic growth, using the neoclassical growth model. It finds that the increases in the investment rate have been a secondary source of growth, contributing less than 1 percentage point to India's overall growth rate of GDP per worker of 2.7%. It also shows that the current investment boom will have a very small effect on future growth rates and that

In the last decade, India's investment rate has burst into the dizzy heights of the East Asian miracle. Having quadrupled since 1950, investment as a fraction of the gross domestic product (GDP) is now in the 30%-40% range. What impact has this had on India's growth, and what does the acceleration in investment imply about growth over the next decade? In attempting to answer these questions, many studies, including Athukorala and Sen (2002), Bardhan (2006), Basu and Maertens (2007) and Basu (2008, 2009), have pointed to the key role of investment in understanding India's past and future growth prospects.

A rather different perspective is given by Bosworth et al (2007). They describe the contribution of capital growth as dis-appointing, and suggest that it has been a constraint on growth. This view is reiterated in Bosworth and Collins (2008), where the authors compare India, East Asia and China.

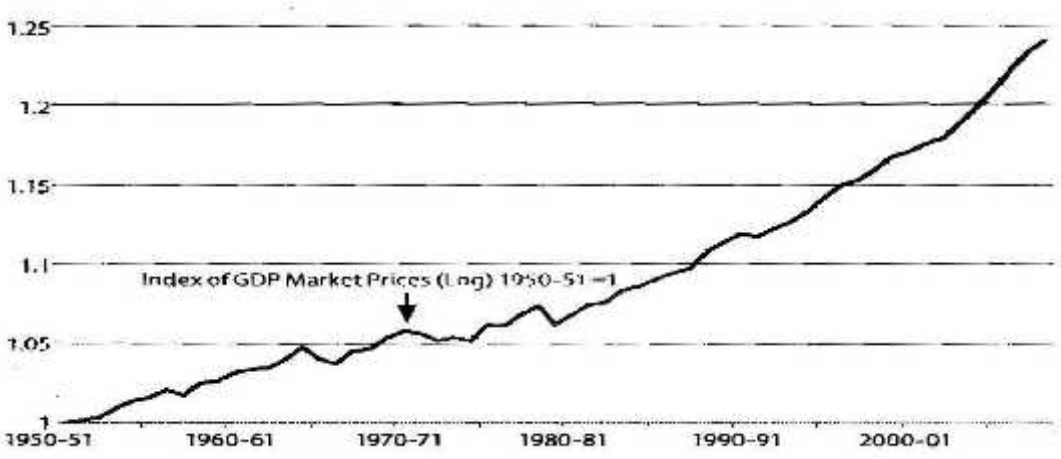
In what follows I aim to explain how growth accounting results and how the rising pattern of investment rates give such different impressions of India's growth record. I shall argue that, notwithstanding Bosworth et al's (2007) muted assessment, the pattern of investment and capital accumulation has indeed been very healthy. This assessment is based on the neoclassical growth model, rather than traditional growth accounting.

That a policy focus on further increases in investment would be misguided. To see this point, one need only recall Krugman's (1996) satire of savings and investment economic policy in Singapore, where he compared it with Stalinist collectivisation. Too much investment will inevitably mean the funding of projects with poor rates of return. For India, this may be at the expense of consumption for basic needs and spending on useful social projects. It follows that, at some level, further increases in investment rates must be harmful. But how much is too much?

1. Perspectives on India's Investment Record

Figure 1 (p 121) shows an index of GDP per capita for India, in logs, since 1950. The graph indicates acceleration in the growth rate since the mid-1970s or early 1980s. Differing views regarding the timing of this acceleration and their relation to reforms have been expressed by Rodrik and Subramanian (2004), Panagariya (2004) and Sen (2007). As noted by Sen (2007), the timing of the acceleration

Figure 1: Logarithmic Index of Real GDP (Constant 1999-2000 Prices)



Source: Reserve Bank of India (2010)

depends on whether the year 1979, in which there was an oil price shock and a drought, is regarded as an outlier. Most analysts agree, however, that the higher growth rates have been sustained by the widespread reforms of the 1990s. Data from the Reserve Bank of India (RBI) thus show that India's growth rate of per capita income over the 50-year period, 1950-2000, was 2.2% per year. But since 2000 the average growth rate has been 5.8% per year.

Figure 2 shows India's gross domestic savings rate, gross fixed investment rate and net fixed investment rate. It shows a massive increase in savings and investment as a fraction of GDP from around 80% -9% in 1950-51 to a peak of 35% of GDP in 2008-09. These savings and investment rates compare favourably with the peak savings rates achieved by Japan, south-east Asia and China, in each of their respective economic miracles. The acceleration in investment and savings is fairly smooth except for a lull in the reform era of the 1990s, when rates remained relatively constant Corresponding to the rise in growth rates there is also a clear jump in all series since 2000.

The large rise in investment rates has featured in explanations of India's growth acceleration. According to Basu (2008), for example, the rise in the savings and investment rates was the most significant macroeconomic change that occurred in India through the 1970s. He attributes the subsequent growth in the 1980s to the earlier acceleration in investment rates. A persuasive link between early reforms and rising savings rates is given by Athukorala and Sen (2002) and Virmani (2004), who attribute the rise in savings rates in the 1970S to the nationalisation of banks in 1969, and the spread of branches to rural areas. Bardhan (2006) and Mohan (2008) also note the complementary effects of public investment over this period. During the 1980s the investment rate continued to rise and Sen (2007) attributes this to a falling relative price of equipment due to the relaxation of import controls and increased access to imported machinery.

In addition to the acceleration in the investment rate, Sen (2007) argues that the investment in machinery and equipment has been associated with embodied technological progress. In his paper, "Why Did the Elephant Start to Trot?", he points to correlations between total factor productivity (TFP) growth and equipment investment in the Indian data, suggesting that investment is a cause rather than an effect of productivity growth. This builds upon a significant body of literature, including De Long and Summers (1991) and Greenwood et al (1997) that stress the role of investment spending in generating growth through technological externalities. There is also some empirical support for the proposition from prominent studies such as De Long and Summers (1991) and Levine and Renelt (1992).

Nevertheless, the link between equipment investment and productivity growth is much more of a hypothesis than an established fact. Specifically, the theoretical links between investment and growth are widely debated. Prescott (1998), Hall and Jones (1999) and others, for instance, have argued that the role of investment or capital accumulation in understanding differences in income levels across countries, is very small, So, without necessarily discarding the link between investment and productivity growth, it is useful to begin with the more fundamental issue of sorting out how the increasing share of income devoted to investment has had an impact on the growth rate in the context of the standard neoclassical growth model.

2. A Balanced Growth Path?

As highlighted in the introduction, the evidence of large increases in the investment rate, emphasised by Basu (2008) and Sen (2007) and others, contrasts strongly with Bosworth and Collins (2008) and Bosworth et al (2007), who find only a very modest capital contribution to India's growth. The data used in Bosworth and Collins (2008) show that between 1978 and 1994, India's per capita output growth was 3.30% and the growth rate of capital was similar, at 3.25%. By comparison, in the East Asian average, the capital growth rate was 5.5%, which was much faster than the average output growth rate of 3.7%.

Figure 2: Investment and Savings (Per cent of GDP at current market prices)

Source: Reserve Bank of India (2010)

Therefore, capital accumulation has played a much less prominent role in India's growth relative to East Asia over this period. Bosworth et al (2007) argue that a poor investment climate is responsible for low investment incentives. In particular they suggest that a lack of public infrastructure is reducing private investment.

There is a broad consensus over the woeful state of India's public infrastructure and many studies concur with the need to improve the investment climate (Kochhar et al 2006). Nevertheless there is room for dissent as to whether India's overall investment growth rate really reflects such a dismal effort. Specifically Bosworth and Collins' (2008) data show that the growth rates of capital and output are approximately the same. This is precisely what one would expect along a steady state growth path. It suggests that the rate of capital accumulation was about right!

In contrast, East Asia's faster rate of capital growth means that the ratio of output to the capital stock, *y/k*, is falling. This falling capital productivity reflects Krugman's (1996) remark that "Lee Kuan Yew's Singapore is an economic twin of Stalin's Soviet Russia". Thus, though many east Asian economies had high savings and investment rates, it is highly debatable that the 40% rates of Singapore were necessary, or even desirable. Taiwan and South Korea achieved equivalent growth rates with only a fraction of the investment. As shown by Robertson (2000), the growth rates in Singapore would have been only marginally less even if it had halved its investment rates.

So an equally valid interpretation of the data presented by Bosworth et al (2007) might be that India's rate of capital accumulation was about right, and that of the East Asian economies and China are too high

This is not quite right however. The argument that India is, even approximately, on a steady state growth path is wrong since a strongly rising investment rate is inconsistent with a steady state. Rising investment rates, other things being equal, will imply higher growth rates of capital over a transition and a falling capital productivity, *y/k*. The standard neoclassical growth model implies that a doubling of the investment rates should cause a halving of *y/k*. Bosworth and Collins' (2008) data, by contrast, imply a constant *y/k*, since both the growth rates of capital and GDP per worker were approximately equal. To resolve this paradox we need to trace India's growth path more carefully. Extending Sen's (2007) metaphor, we need to follow the elephant's trail, looking at how *y/k* behaved over time.

3. The Elephant Trail

I begin by looking at Bosworth et al's (2007) output and capital stock data. Figure 3 compares the*y/k* series based on official data reported in Sivasubramonian (2004), the data used by Bosworth et al (2007), as well as the latest series taken from the RBI.

It can be seen first that, in the 1978-2004 period, there was considerable fluctuation in the *y/k*: ratio, but little net change since 1978. The data show very clearly that the average product of capital*y/k* has not been falling and, if anything, has been rising.

What causes *y/k* to rise, or remain constant, in the face of the strong investment growth? The neoclassical growth model suggests three factors: labour force growth; the depreciation rate; and productivity growth. Specifically, let (1 +*n*) denote the annual

Figure 3: Average Product of Capita (*y/k*)

All the data series are identical prior to 1993-94. Source: Reserve Bank of India (2010)

increase in labour inputs, (1 +*g*) denote the annual increase in productivity, measured in effective labour units, and δ denote the depreciation rate on capital. The steady state condition for the Solow-Swan Growth model is $sy/k = (1+n)(1+g)-(1-\delta)$, where sis the investment rate." Using this, the steady state equilibrium output-capital ratio is,

$$Y/k = \frac{(1+n)(1+g)-(1-\delta)}{s} \quad \ldots (1)$$

A constant value of *y/k* will indicate a balanced or steady state, only if all of these variables, *s*, *n*, *g*, δ, are constant. In this case a doubling of the investment rate would halve the equilibrium value of*y/k*. As we have seen, this was not the case, In India there was a fourfold increase in s since 1950, but*y/k* did not fall to one quarter of its initial level. Rather it increased!

Alternatively, consider a growing economy, like India, where *n* and δ are approximately constant but both the investment rate, *s*, and the productivity growth rate, *g*, are rising. What happens to capital productivity is a balancing act between increases in *g* and increases in *s*.

The principal reason why the fourfold increase of the investment rate has not led to a rapidly falling value of *y/k* is that there was also a rapid acceleration in the rate of productivity growth, *g*. Based on data from Bosworth and Collins (2008), the average value of productivity growth from 1951-79 was *g*=1.4%, but from 1980-2008 the average is *g* = 4.4%. A simple calculation using (1) shows that this 3 percentage point increase in *g* is sufficient to raise the average product of capital by approximately 50%.

Thus India has not been on a steady state, but on a slowtransition with rising *s*and *g* and an approximately constant average product of capital, *y/k*, This is what lies behind Bosworth and Collins' (2008) results showing that capital growth rates have been similar to GDP growth rates. Because productivity growth was also trending upwards, the capital productivity ratio *y/k* has tended to be fairly constant and the growth rates of capital and GDP have been approximately the same. This means that capital has contributed less, relatively, to India's growth than it did to the East Asian economies. But this is due to the acceleration in productivity growth. It does not mean that the investment rate increases have not been important or substantial.

There is one caveat, which is to do with depreciation rates. Though productivity growth rates have been rising, so too has the implicit depreciation rate. The net investment rate, calculated as $(k_{t+1} - k_t)/y_t$ has been much more constant over time than the official gross or net investment rates shown in Figure 2. Thus the relationship in the data between the gross investment rate and changes in the capital stock has not been constant.

Whether one attaches much importance to this depends on whether one believes that the accounting practices in national accounts reflect real economic depreciation or not. But it does help explain the different pictures painted by the investment optimists (who refer to gross investment data) and Bosworth et al (2007, 2008) (who base their conclusions on the growth rates of capital).

The central insight then is that the increases in investment rates have been large and consequently there has been a high rate of capital accumulation. With a constant rate of productivity growth, at any level, the increases in the investment rate would have caused the average product of capital to fall sharply. Because the rate of productivity growth was also accelerating, the growth rate of capital remained fairly close to the growth rate of output. This pattern of growth ensures that the growth accounting "capital contribution" will be close to the assumed capital share and that *y/k* remains fairly constant. But this in itself does not mean that the investment process has been restricted or is inadequate.

4. The Long Investment Boom

We have seen that the "capital-contribution" in growth accounting results depends on both the investment rate and the rate of productivity growth. It does not tell us how the change in a potentially interesting policy variable, the investment rate, affects the growth rate. This, however, would seem to be a useful way of approaching the issue of evaluating the role of the increases in the investment rate. To do this we need a growth theory. As above, the most useful starting point is the standard textbook Solow-Swan or Ramsey neoclassical growth model.

In the Solow-Swan growth model, the impact of an increase in investment from *s* to *s'* on the growth rate of per capita income is given by

$$y'/y = (s'/s)^{\alpha(1-\alpha)}, \qquad \ldots(2)$$

Where α is the income share of capital, and *y*' refers to the new steady state level of per capita income. With a capital income share of α = 1/3, we have α/(l-α) = 0.5. This gives a useful "square root rule" - for example to double GDP per capita we need to quadruple the investment rate. India's investment rate has indeed approximately quadrupled since 1950, from 9% to 35% of GDP. But income per capita over this period has increased fivefold. Thus over 58 years, the doubling of GDP due to the quadrupling of the investment rate translates into an average annual growth rate of 1.2% per year, relative to the average growth rate of GDP per worker of 2.7%. Thus, by this measure, the quadrupling of the investment rate accounts for approximately 44% of India's average growth.

This, however, is an overestimate since the changes in investment are gradual and the peak rate has only reached in the last few years. A slightly better back-of-the-envelope calculation can be obtained by dividing the investment rate rise into two periods where the investment rate doubled: 1950-80 and 1980-2008. For the first of these we can assume that the transition is complete by 2008 and hence has led to a 40% increase in per capita GDP, since$y'/y = 2^{½} = 1.4$.

Since increases in the investment rate raise income through capital accumulation, it takes time for the full impact to be realised. Hence, for the second period 1980-2008, it is likely that only 3/4th of the actual transition has been realised by 2008, so that increase would be approximately 3/4th of 40% - that is a 30% increase in GDP. This is based on an assumed convergence rate of 5% which implies a transitional half-life of 14 years. The half-life of 14 years means that 3/4th of the transition would be realised over the 28-year period 1980-2008. Simple arithmetic gives the total increase then to be 1.85. Thus this back-of-the-envelope calculation suggests that the fourfold increase in the investment rate has generated an 85% increase in per capita GDP over the whole period. That translates to about 1 percentage point per year over 58 years or 37% of the actual annual average growth of 2.7% per year.

Even this estimate of 1 percentage point of growth is likely to overstate the contribution of the investment rise, since much of the investment boom is very- since 2000. Hence we might reasonably view 1 percentage point of India's 2.7% average growth as an upper bound estimate.

Moving beyond back-of-the-envelope calculations, it is possible to quantify the effect of the rise in the investment rate on average growth rates precisely using simulation methods. As discussed by Robertson (2000), the actual growth experience can be simulated using existing growth accounting data and actual changes in investment rates. A counterfactual simulation using this simple calibrated model, with investment rates held at the 1950 level of 9% of GDP, yields the actual growth that would have occurred in the absence of any rise in investment rates. This shows that the rise in investment rates since 1950 accounts for approximately 0.76 percentage points ofIndia's 2.7% average growth rate of GDP per worker, or 28% of India's overall growth.

This reduced figure still suggests that investment has been very important. But it also emphasises that the gains from investment rate rises are distributed over a long period so its impact on growth rates over many decades is modest.

5. Investment in the Future: How Much Is Too Much?

The preceding arguments suggest that investment rate rises have been an important, but secondary source of growth in India. When one looks to the future, however, the role of investment rate rises must necessarily be even smaller. This is mainly because the recent investment boom has raised investment rates to a level where it is difficult to generate further income growth.

Specifically, in this decade, India's investment rates have increased from 25% to 35% of GDP. This is a 10 percentage point increase in a short time. However, the effect of a change in the investment rate on the growth rates depends on percentage changes, and not on the absolute change. Thus, using the square root rule from (2), increasing the investment rate from 25% to 35% only implies a l.l8-fold, or 18%, increase in per capita incomes over a full transition. With a transition half-life of 14 years, this change in the rate of investment implies a 9% increase in income levels over the next 14 years, or approximately 0.6% per year from 2000-2014. Though 0.6% is a significant number, it will only account for a small fraction of India's growth in the near future growth rates of around 6%-7% per year.

Thus the neoclassical growth model suggests that each percentage point rise in the investment rate has an increasingly smaller effect on the income level and on the growth rate over a transition. Hence, the most recent investment rate increases will have a smaller impact than past increases of a similar absolute magnitude. Likewise, any further increases in the investment rate must play an increasingly diminishing role in India's growth and may be costly in terms of foregone consumption opportunities.

6. Conclusions

Despite the stratospheric investment rates of recent years, the picture that emerges for India is that rising productivity has been the key ingredient of economic growth. Specifically, the lack of change in the capital-output ratio, or its inverse*y/k*, is not due to a lack of capital deepening, but due to an acceleration in the productivity growth rate. Thus, without disputing any of the facts, this gives us cause to reconsider Bosworth et al's (2007) gloomy assessment of India's record on capital accumulation.

But one may also take issue with the upbeat assessment of investment. Can further increases in investment really keep the elephant trotting? Perhaps inauspiciously, recent research shows that Asian elephants cannot actually run in a technical sense. They are simply too big and heavy. The metaphor is apt since the neoclassical model also suggests that adding capital without productivity growth will cause India to stumble under the weight of a large and inefficient capital stock.

Of course, the neoclassical model is not the only theory of growth. Much of the productivity growth that has occurred may depend upon productivity improvements that are embodied in new capital goods, or on economies of scale. For example, this is the view of Sen (2007).

But the importance and existence of the sources of productivity growth are contentious and not well understood. Like growth accounting methods, the preceding analysis is appropriately, silent on the sources of productivity growth. Rather, it aims to build upon standard growth accounting methods to provide a deeper understanding of the relationship between investment and growth. Within the context of that model, we have shown that the fourfold increase in the investment rate has produced some significant growth over the post-independence era.

Nevertheless, productivity growth clearly dominates. Moreover, with an investment rate now above 30%, a similar percentage increase in the investment rate is highly unlikely. Even if it does occur, the square root rule means that it is unlikely to generate any significant growth benefits. Hence productivity growth, and not investment, will dominate India's growth over the coming decades.

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