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Where is India's Growth Headed?

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Abstract

Growth in India declined in the post financial crisis years both due to external and domestic factors. While the slowdown appears to be largely cyclical, it is possible that trend growth may also have been affected especially by negative shocks from the domestic policy environment. In this paper, we analyze the sources of output growth in the past three decades and discuss the outlook going forward. We make projections for the growth of factors of production and the growth of trend GDP per worker for the period 2013-2030. In general, the outlook for factors appears strong. As long as policy reforms support the broad environment for investment in infrastructure and in education and eliminate frictions in the efficient use of labor and capital, all of which can also boost productivity, it does not appear that trend growth is likely to decline in the future.

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1. Introduction

The recent decline in investment in India has raised concerns about an ongoing economic slowdown. There appear to be elements of both a business cycle and trend slowdown. We see a cyclical downturn post-financial crisis caused by external and domestic idiosyncratic factors. India's economy was part of the global slowdown owing to its trade and financial linkages with the rest of the world. Further, over exuberance in investments in infrastructure and non-infrastructure capital due to easy financing conditions faced a correction post-crisis, dragging down growth below its long-term trend.

Besides external and domestic cyclical reasons, investment projects were also stalled due to policy decisions, or in some cases, policy inaction in the face of regulatory hurdles and severe bottlenecks in factor markets. The policy framework that hampered firms' investment activity and investors' business confidence acted like a negative shock which could have affected the long term component of output growth, namely the trend.

Against this backdrop, we ask the question: where is India's growth headed? We argue that there are two reasons to support the long run growth of output. One is that negative shocks to trend arising from policy uncertainty can be rendered temporary by appropriate policy changes that can act as positive shocks to growth. Aguiar and Gopinath(2007) show that emerging economies are subject to shocks to their trend growth due to repeated policy changes. Accordingly, a positive supply-side shock causes trend growth of output to increase while a negative shock causes a decline. Thus, in their framework, trend growth itself becomes cyclical. The policy uncertainty and inaction in India, with frictions in various factor markets, may be such a negative shock to trend growth. But appropriate policy changes aimed at reform can resolve the bottlenecks so that the negative shock has a temporary effect. These policy changes can in turn act as a positive shock to growth. The question is if India has the institutional framework to overcome negative shocks through such policy reform or not. Pritchett and Summers (2014) make the point that institutional reforms are crucial, but the process of reform may itself result in slower trend growth in the erstwhile rapidly growing Asian economies. In the case of the China, they argue that transition away from a political system characterized by a high degree of state control, authoritarian rule, and corruption makes growth deceleration very likely. We believe that India's story is different in this regard. The country has already gone through various difficult stages of learning to operate a democracy and has reached a level of political maturity. The major problem of transition that they believe China faces at this point which can constrain growth is not a risk for India. While so far, the political process has not managed to achieve support for all the required reforms, the institutional capability to do so certainly exists.

The second reason for believing that trend growth can be strong going forward is that the long run supply of factors of production – namely labor, human capital, infrastructure and non-infrastructure capital which contributed to growth in the last three decades appears to be robust; and total factor productivity which measures efficiency of inputs has a potentially strong growth path as well. First, the supply of quality-adjusted labor does not appear to be declining given that the proportion of the population in the working-age group is favorable to a strong supply; there is scope for increasing the labor force participation rate (LFPR); and education and skill levels are low, but improving. Then, though investment has slowed recently, the rate of gross fixed capital formation in India is still high at around 30 percent of gross domestic product (GDP) and the growth of capital stock remains one of the highest among emerging economies. On the other hand, there are concerns that capital stock may be growing slower in the future for several reasons including declining private and public saving rates in India. Again, barring the recent slowdown, investment in infrastructure capital has been increasing over the years, and additions to the physical stock of infrastructure, in terms of roads, rail, telecommunication networks, remain strong. Of course, there are a number of frictions in these input markets, and even if sufficient and high quality resources are available, laws and regulations must enable their efficient allocation to meaningfully contribute to output growth in the future. In other words, paucity of resources is not the main problem; it is the policy environment that does not allow their most productive use that will impede future GDP growth.

Finally, the strong output growth in the past three decades was not only due to additions to labor and capital, but also because of improvements in productivity. Total factor productivity (TFP), computed as a residual in the production function, dragged down growth in the 1980s, but has been increasing since then to become a key contributor to growth. Based on the literature on factors facilitating productivity growth, such as globalization and learning, development of information and communication technologies in India, and spillovers from infrastructure development, we conjecture that productivity can potentially leap forward to the frontier with the right policy environment.

In the analysis, we distinguish infrastructure capital from other types of capital because this capital, which consists of transportation networks, telecommunication, irrigation, power, fuel, and other utilities like water supply, has externalities to other factors of production. The public nature of this capital often requires public investment for its development, in general, and certainly did in India in the past. More recently though, private sector participation across all infrastructure sectors has increased to meet the gaps in investment.[1] Nonetheless, infrastructure capital being subject to various types of government regulations, interventions and pricing policies, may not receive the same share of income as non-infrastructure capital that is assumed to receive its marginal product. Also, the role of infrastructure capital in generating economic growth has been emphasized in the literature, particularly for developing economies; hence, we measure infrastructure capital separately in the growth accounting framework.[2] To this end, we construct an index for infrastructure capital using multiple dimensions of physical infrastructure, namely roads, electricity, and telecommunication.

We decompose trend growth of GDP per worker into its components for the period 1980–2013 using a growth accounting approach based on a Cobb-Douglas production function. This suggests that while capital has always been a key contributor to growth through the decades, the role of TFP has assumed greater importance in recent years. Both human capital and infrastructure capital also are important for growth. We make assumptions for the growth of factors of production to project trend growth rate going forward (2014–2030). In the baseline scenario, we project trend growth of GDP per worker to be 6.5 percent on average and present some downside and upside scenarios of alternative growth paths.

In other analyses of long-term growth, typically cross country studies, similar optimistic results as ours are obtained for India. The models have the same basic ingredients of trend output determined by a Cobb-Douglas production function with constant returns to scale featuring physical capital, human capital and labor as production factors along with TFP. The trend input components are projected for a period of 30 or 40 years, sometimes using a convergence framework in a multi-country setting, particularly for TFP growth. However there are differences in the measures used for each input series, the exact time period of projection, and in the assumptions underlying the projections due to different structural policies; hence the numbers may not be directly comparable. For example, Duval and de la Maisonneuve (2010) project

1 NTDPC(2014) estimates that overall private sector investment in infrastructure has increased from 30% in 2002 to 40% in 2011, while in some sectors like telecommunications, private sector investment was over 90% in 2011.

2 Straub (2011) for a review of the innumerable empirical studies written since the 1980s, assessing the role of infrastructure capital in output growth.

average growth of trend GDP to be 6.2 percent in the period 2005–2050 in a baseline scenario. They also include education and pension reforms, and then the growth rate of GDP is projected to be higher at 6.5 percent. Johanssen et al. (2013) emphasize labor market policies, and they project the average growth in trend GDP to be 6.7 percent and GDP per capita to be 5.6 percent in the period 2011-2030. Foure, Benassey-Quere and Fontagne (2010) include energy productivity in their assumptions; they project GDP growth in the period 2012–2025 as 6.5 percent. On the lower side, OECD (2012) projects potential output per employee growth at 5.3 percent and 4.6 percent in the periods 2012–17 and 2018–2030 respectively. In terms of potential real GDP growth, they obtain an estimate of 6.5 percent in the latter period which is the highest among the 40 odd countries studied. In a global setting, PwC (2013) projects India to be a key driver of growth in the next few decades and to become the third largest economy (after China and the USA) by 2050. It is noteworthy that in all these cross country projections, with their different inputs, data variables and projection assumptions, India is estimated to have the highest growth rate in the world by 2050, particularly in the period after 2020 when China is expected to slow down. Even using a completely distinct approach by constructing an economic complexity index, Hausmann and Hidalgo(2014) project that by 2020, India will be ranked second after China in terms of per capita GDP growth among 128 countries.

The remainder of the article is structured as follows. In Section II, we discuss the business cycle slowdown in the Indian economy post the global financial crisis. In Section III, we describe the supply patterns of factor of production in the past 3 decades and their likely growth paths in the future. In Section IV, we decompose output per worker growth into its components and make projections from 2014–2030 for the growth of various factors to compute trend growth of output per worker and provide alternative scenarios. In the last section, we summarize and conclude.

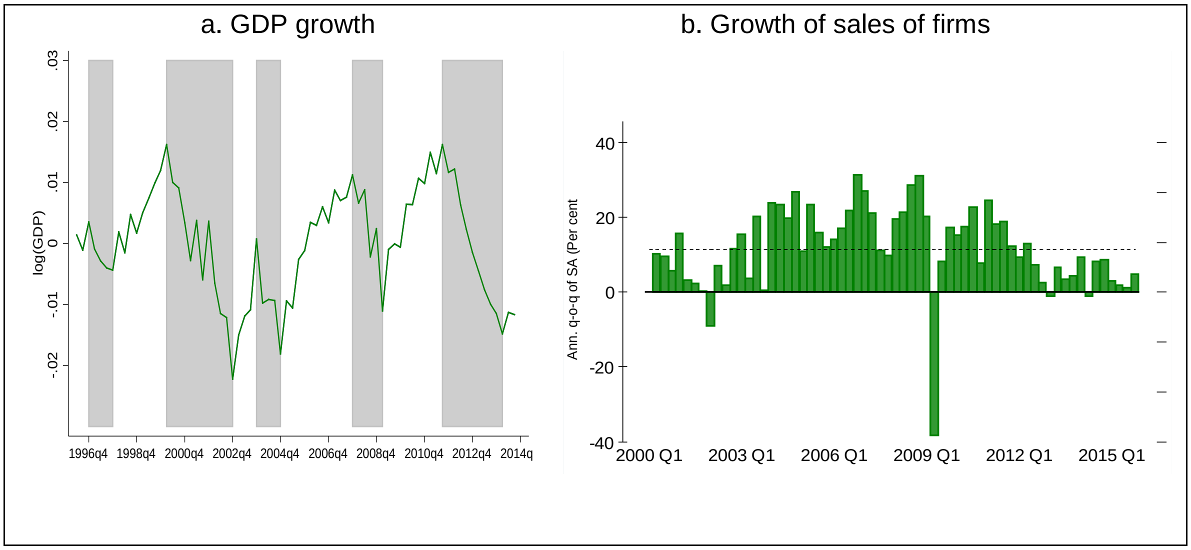
2. Business Cycle Slowdown

Since the liberalization reforms in 1991, the Indian economy is subject to business cycle fluctuations with high output volatility, a characteristic feature seen in emerging economies.

We use quarterly real GDP to capture the business cycle conditions in the recent years.[3] By applying Hodrick-Prescott (HP) filter to the log of the series, we obtain the cyclical component (Figure 1.a).

[3] The analysis in this paper is based on GDP at constant prices using the 2004-05 base, as the series using the latest base year 2011-12 has only three years of data, two of which overlap with the old series. We are aware that the growth rates are different based on the two series when there are data overlaps, and the algorithm may predict different turning points in the business cycle. Nonetheless, we present analysis based on the old but longer series in this paper.

Figure 1: Business Cycle



GDP = gross domestic product.
Sources: National Accounts Statistics; Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE) CaPex database.

The shaded portion shows the periods of recession (between the peak and the trough), based on the Bry and Boschan (1971) algorithm. We see a business cycle downturn starting at the end of 2007 that hits a trough in the first quarter of 2009. Then there is an uptick in the cycle, which reaches a peak in the third quarter of 2011, after which we again see a downturn. Table 1 shows the business cycle peaks and troughs identified by the Bry and Boschan (1971) algorithm applied to the cyclical component of HP filtered real GDP.

Table 1: Business Cycle Peaks and Troughs

Peaks	Q4 1996	Q1 2000	Q1 2003	Q4 2007	Q3 2011
Troughs	Q4 1997	Q4 2002	Q4 2004	Q1 2009	Q1 2014

Source: National Accounts Statistics, and author's computation based on Bry and Boschan (1971).

We plot another indicator of cyclical fluctuations in the economy, namely, the growth of sales of big firms. Figure 1.b shows the annualized quarter-on-quarter growth rate of seasonally adjusted nominal net sales of non-oil, non-finance firms. The growth rate of net sales started declining in the third quarter of 2010, picked up tentatively for some quarters and again showed a drop towards the end of 2011. In the last fourteen quarters, net sales are below the long-run median growth of 11.2%.

By these measures, India experienced a business cycle slowdown in 2008 along with other emerging economies during the global financial crisis (IMF 2013). This could be the result of greater synchronization of domestic cycles with global cycles. The economic downturn, which started in the advanced economies, spilled over to India and also to other emerging markets through trade and financial linkages. During the crisis, when economic growth and activity slowed down, export demand in advanced countries declined. If we look at export growth in India (Figure

2.a), we see a corresponding sharp deceleration. The period was also characterized by a slowdown in investment (Figure 2.b) due to weak external demand and tight financial conditions.

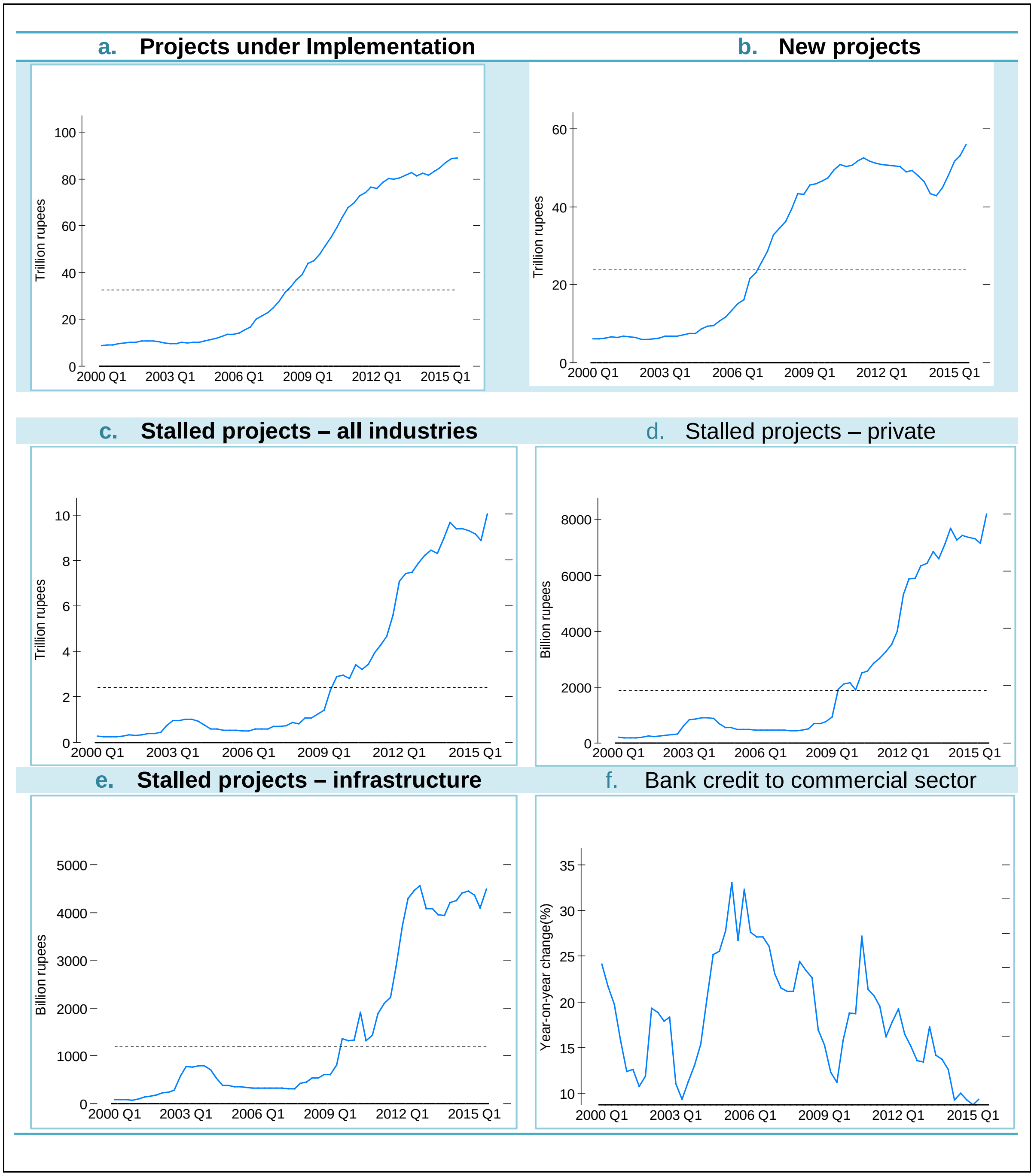
Figure 2: Exports and Investment

a. Year on year merchandise export growth | b. Year on year investment growth

Sources: Department of Commerce and Industry; National Accounts Statistics.

A clearer picture is obtained if we look at firm level data. The value of projects under implementation by non-financial firms increased over the years to reach Rs 73.2 million in 2011, after which it flattened out for a period of time (Fig 3.a). New projects saw a boom between 2007, when it crossed the long-run average, and 2011, followed by a decline (Fig 3.b). On the flip side, projects under implementation in all industries, and in private and infrastructure firms that were stalled drastically increased after 2008 (Fig 3.c,d,e). The chart on bank lending to the commercial sector gives an insight into the slowdown in investment activity of firms (Fig 3.f). The economy witnessed an upswing in the cycle, primarily led by high credit growth during the boom years of 2005–07 when firms borrowed and initiated a number of projects. But with the onset of the crisis, when export demand declined and investment was affected by adverse global conditions, many projects that were started earlier became unviable and had to be stalled or shut down.

Figure 3: Firm Data and Credit



Source: Center for Monitoring Indian Economy Pvt. Ltd. (CMIE) CaPex database

The uptick in GDP seen in 2009 was also mainly a business cycle upswing. Concerns about the negative effects of the global financial crisis on the Indian economy prompted the government to announce fiscal and monetary stimulus policies in 2008–2009. For example, the government introduced three fiscal stimulus packages in the form of tax cuts and increased expenditure to boost consumer demand and production in key sectors. The Fiscal Responsibility and Budget Management (FRBM) Act, 2003, according to which, the government is required to follow fiscal prudence to reduce its deficits to a target rate, was suspended in 2009 in order to accommodate the stimulus policies. On the monetary side, the Reserve Bank of India introduced measures, such as rate cuts, to increase liquidity and ease credit in order to boost investment. Guidelines for External Commercial Borrowing were also liberalized to ease firms' access to external finance.

Since the latter part of 2011, again, we saw a business cycle slowdown, partly because the domestic stimulus measures were withdrawn. More recently, with the slight but tentative improvement in global activity, especially in advanced countries, it remains to be seen if through spillovers, domestic business cycles conditions will pick up.

Besides external and domestic cyclical reasons, investment projects were stalled also due to policy decisions, or in some cases, policy inaction in the face of regulatory hurdles and severe bottlenecks in the economy related to land acquisition, corruption scandals, taxation, etc. The policy framework that hampered firms’ investment activity and investors’ business confidence acted like a negative shock that could have affected the long-term trend growth of output. But reforms can act as positive shocks that can reverse the negative effects provided there are sufficient resources to sustain growth in the long term. In the next section, we discuss patterns in the supply of inputs to production that determine long-run output growth to understand in what direction trend growth in India is heading.

3. Long Run Supply of Factors

Output growth is determined by the supply of factors of production. We discuss the patterns in labor, human capital, physical capital, and infrastructure capital supply, and comment on productivity growth in India.

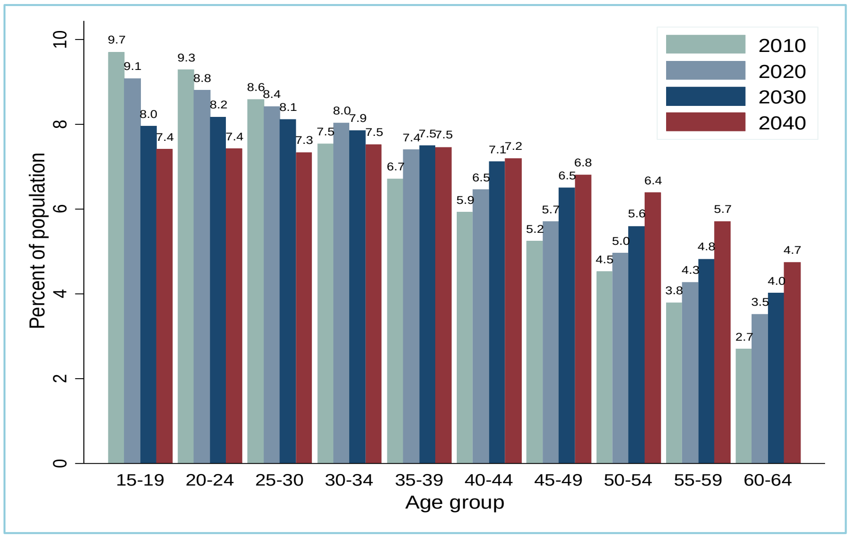
3.1 Labor and Human Capital

Labor supply has two components—the number of workers and the quality of workers—that we conceptualize as human capital. The long-term trend of labor supply in terms of number of workers and hours of work is determined mainly by demographics. India's demographic transition into a bulging workforce began in the 1980s. The working-age population (15–64) has been rising by 2.3 percent on average every year (adding approximately 13 million people).

Figure 4 shows that, currently, 64 percent of the total population is in this age group. Over 35 percent is “young,” i.e., below 34 years of age, and will remain in the working-age group in the next 30 years. Moving ahead, the age structure of the population (due to declining infant mortality and fertility rates) is such that India is projected to have a steady increase in the working-age population for the next few decades[4] According to population forecasts from UN 2015, the working age group will increase to constitute 67.8 percent of the population by 2030.

[4] PwC (2013) notes that among the 24 emerging and advanced countries they study; only India does not see a declining share of total population in the 15–59 working-age group between 2011 and 2050, based on United Nations (UN) projections.

Figure 4: Percentage of Population in Each Age Group



Source: Population projections from UN (2015)

For human capital, education and development of skills drive long-run growth. Human capital, which started out at a low level in India, has been increasing steadily (Table 2). In 2012, over 75 percent of the population was literate, and it is reasonable to expect that the literacy rate will reach 100 percent in the near future.[5] Other measures of educational attainment, such as percentage of the working population with primary, secondary, and tertiary education as the highest level attained also show improvement. A widely used indicator to measure human capital, the average number of years of schooling per person, has also increased over time, though it is still quite low at 6.6 years in 2010. But starting from a low point provides tremendous scope for improvement, and the impact on growth of even small increases in educational attainment of the population can be considered.[6]

Table 2: Educational Attainment

		Highest level attained (% of population aged 15-64)			
	Literacy Rate (%)	**Primary**	**Secondary**	**Tertiary**	**Years of Schooling**
1980	58.7	27.4	1.7	1.3	2.5
1990	62.8	40.3	2.3	2.4	3.6
2000	68.1	27.8	23.6	4.6	5.3
2010	75.1	34.3	29.1	5.3	6.6

Note: Literacy rate is weighted by population.
Sources: World Bank, World Development Indicators online database; Barro and Lee (2012), version 1, July 2015.

Not everyone in the working-age group may be in the labor force; hence, another area for improvement is the LFPR, i.e., the number of people in the working-age group actively seeking

5 The World Bank measures literacy as being able to, with understanding, read and write a short, simple statement on everyday life as well as do basic arithmetic.

6 In a cross-country study, Johanssen et al. (2013) assume that educational attainment of cohorts in the age group 25–29 in all countries slowly converges to a world frontier over the next 50 years. By this methodology, they project that increases in education are particularly sizable in India, which starts off at a low level.

employment. This is particularly relevant since the LFPR, which was around 60 percent from 1990–2005, started declining and stood at 55.5 percent in 2012, driven primarily by falling female LFPR. Not only is the rate declining, India has one of the lowest female LFPR rates among developing and emerging economies.

In general, the supply of quality adjusted labor does not appear to be declining, given that the proportion of population in the working-age group is high, that there is scope for increase in the LFPR, and that education levels and skills acquisition are low but improving. However, even if abundant labor and human capital are available, they have to be properly absorbed into the production process to meaningfully contribute to output growth. Reforms in laws and regulations governing the labor market are required to reduce frictions and inflexibilities, to facilitate better reallocation of labor resources, to allow wage adjustments, to absorb labor into the formal sector, and to encourage female participation. Besides, increased expenditure on schooling, education and skill development with a focus on improving the quality and diversity of human capital to meet the country's economic needs can provide a boost to output growth.

While the absence of reforms in the labor market may have negatively affected the trend growth of output, we can expect that the initiation of such reforms can reverse the pattern, since there is sufficient labor capacity available to meet the demands of a growing economy.

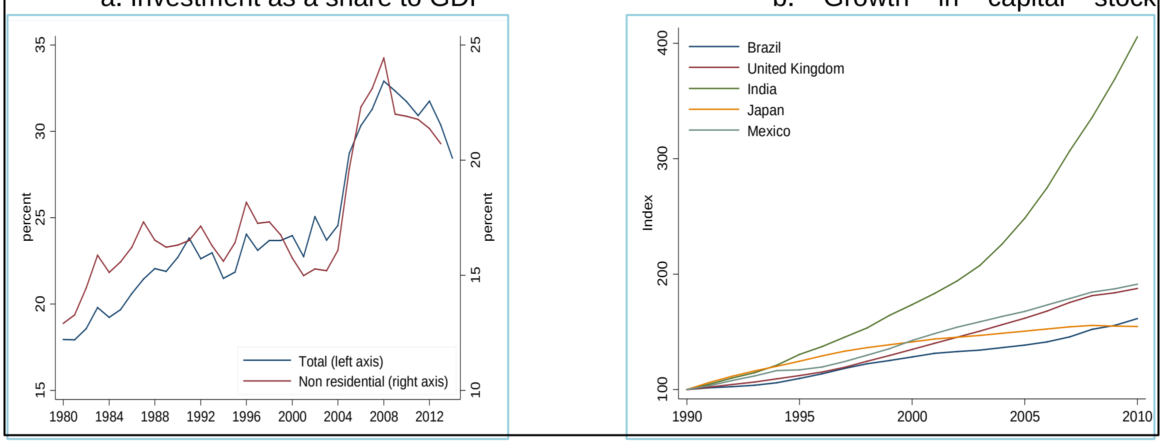
3.2 Capital

Capital stock is a key driver of output growth in the economy. Total investment, measured as gross fixed capital formation (at constant prices) increased steadily from 17.9 percent of GDP in 1980 to 32.9 percent in 2008. Non-residential investment increased from 12.9 percent to 24.4 percent in the same period (Figure 5.a). Since 2008, however, investment has declined. But though it has fallen from its peak value, the rate of investment is still high at 30.4 percent (in 2013). Similarly, non-residential investment remains over 20 percent of GDP in the same year. A comparison across a small sample of emerging and advanced countries shows that the growth rate of capital stock is highest in India (Figure 5.b).[7]

Figure 5: Investment

a. Investment as a share to GDP

b. Growth in capital stock



Sources: National Account Statistics; World Bank, World Development Indicators online database; Authors' calculations.

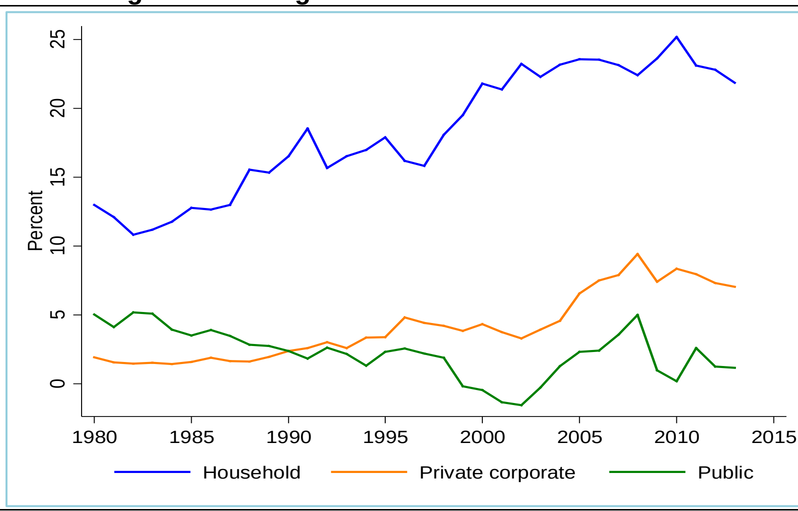
[7] Capital stock for the cross-country comparison is computed with the perpetual inventory method using data from the Penn World Tables.

Though capital supply still appears to be strong, the fall in investment raises serious concerns about the growth of output in the economy. As discussed in Section II, firm level data shows that there has been a decline in new projects undertaken while ongoing projects have been stalled. The slowdown in investment was only partly driven by cyclical factors. A number of negative shocks arising from the policy side increased uncertainty and exacerbated bottlenecks which affected the investment climate negatively. An example is retrospective taxation which dampened investor sentiment severely. Besides taxation laws, policy decisions, and, likewise, policy indecisions surrounding business, financial, labor market, and environmental regulations, and land acquisition laws, also created an environment of uncertainty and hampered the efficient allocation of capital resources.

However, given that there is available capacity (stalled projects may be restarted), and that capital stock is at a comparatively high level, the right policies that create reform, can render the negative shocks that were experienced to be temporary and reverse the decline in investment.

Another factor that could slow capital accumulation going forward is the decline in savings rates in India in recent years. As seen in Figure 6, household and private corporate which were steadily rising since 2008 started declining in the last 5 years, and public savings have been falling as well. But this pattern can be reversed if real interest rates are positive, which would encourage household savings. Corporate savings will rise with business cycle upswings, so we could expect a movement in the positive direction as the economy picks up. Overall, the path of capital accumulation going forward does appear clear cut compared to the pattern in the past decade or so.

Figure 6: Savings Rate as Share to GDP

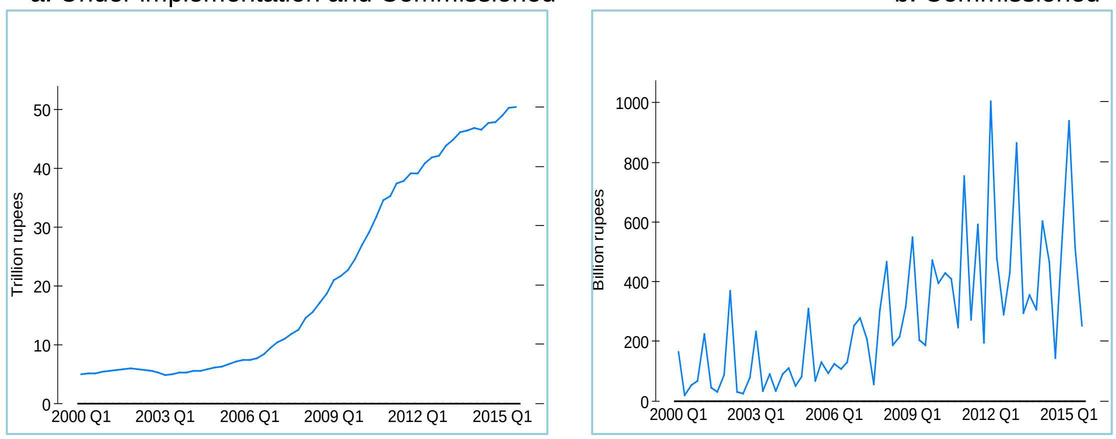


Source: CEIC Data Company, accessed 19 November 2015.

3.3 Infrastructure

The story of the supply of infrastructure capital is similar to regular capital—while accumulation appears strong, the recent decline in investment raises concerns for growth. Following an increase in public investment in infrastructure, such as roads, railways, power, etc., infrastructure capital has been rising in India in the last 30 years. We plot the value of infrastructure projects under implementation (Figure 7.a) and projects commissioned (Figure 7.b) from 2000.[8] The value of projects steadily increased—at the peak, projects under implementation were more than $800 billion and projects commissioned were close to $20 billion.

Figure 7: Infrastructure Projects Under Implementation



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Source: Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE) CaPex database

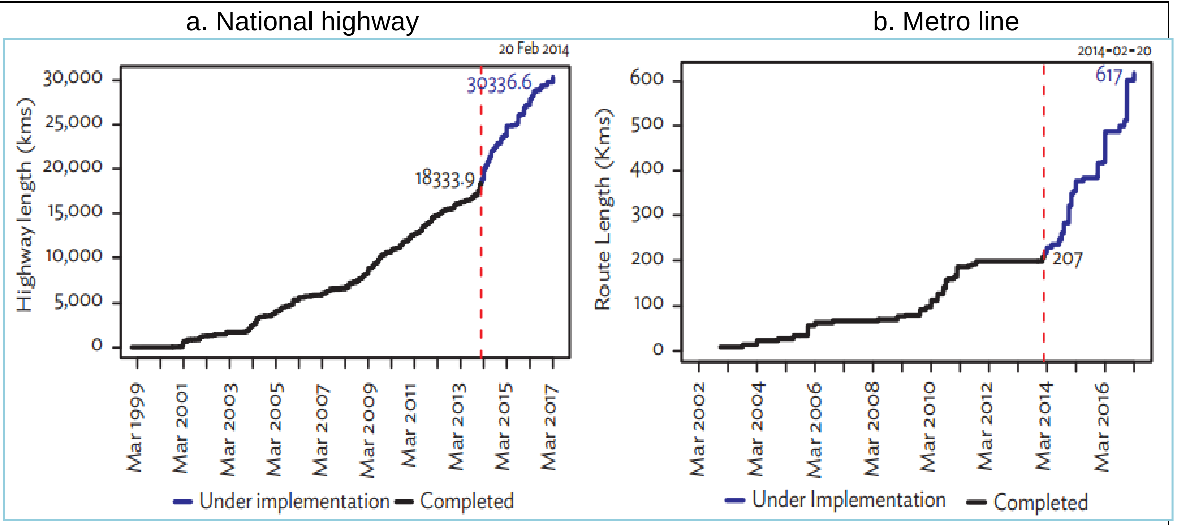
There was a steady increase until 2011, after which, we start seeing a decline in infrastructure investment. Again, part of this fall can be seen as a correction of the over exuberance in investment prior to 2008. Many of the projects that were started were either unviable in terms of business success and profits and were shelved (see Figure 3.e). But another reason for projects being stalled is the messy policy environment which hampered investment activity. Bureaucratic delays in issuing licenses for infrastructure projects; sudden decisions, such as the coal mining ban in some states; policy paralysis in the face of bottlenecks such as land acquisition issues; and corruption scandals all increased uncertainty and negatively affected investment in this sector. But with the right policy environment that would reverse such shocks, can we expect trend growth to improve?

The capacity certainly seems to exist. If we look at additions to actual infrastructure, we get a sense of the kind of growth that is capable of taking place. Figure 8 is an example of infrastructure development in India. The plots show the length of inter-city highways and metro lines constructed since 1999 and 2002, respectively, using data on projects completed. Over a period of 12 years (2002–14), 212 kilometers (kms) of metro lines and 18,334 kms of national highway were constructed, which averages 17.6 kms and 1,527 kms per year, respectively. After 2013, the lines are plotted based on the expected date of completion for projects under implementation, and show continued additions in the future.[9]

8 Infrastructure projects include electricity, storage and distribution, transport services, and communication services.

9 The graphs are constructed based on project information in Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE) database. We used 577 highway projects of the National Highway authority of India (the status of 390 is "completed" and 187 is "under implementation"). The projects studied included 32 metro rails involving 79 metro lines (25 completed and 54 under implementation).

Figure 8: Infrastructure—Roads and Rail



kms = kilometers.

Source: Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE) CaPex database.

The problem is not the lack of capacity as much as frictions and impediments that prevent the optimal use of resources. Stalled projects may be restarted and new projects initiated with the right policy reforms, which can reverse the decline in trend growth.

3.4 Total Factor Productivity

TFP measures the efficiency with which a given combination of factors of production operates in producing output, and hence is a crucial ingredient for long-term growth. If inputs are not increasing or have reached full utilization, which is not the case described above, an increase in TFP can lead to an increase in output by making existing resources more productive. If productivity growth is improving along with increasing inputs, then output growth is stronger.

In India, there are factors that have been highly conducive for TFP growth in the past three decades, and these do not show signs of slowing down. One is openness in the current and capital accounts, and the resulting inflow of financial and physical capital, labor, and skills. The globalization of domestic firms and the flow of foreign direct investment (FDI) has resulted in the cross-border transfer and diffusion of new technology, management practices, and production techniques; and generated competition with international firms. The TFP growth that comes from learning from advanced countries is immense, resulting in a “catching up” to the technology frontier.

Another factor is the growth of information and technology, which also facilitates the process of learning in a significant way. It is well known that India's software sector took off in the 1990s to grow into an internationally competitive and high-tech industry (Patibandla and Peterson, 2002), (Krishnan and Vallabhaneni, 2010).

The development of the software industry, based on science, engineering, and technology, by its nature, represents productivity growth in the economy. Most global information technology firms have a presence in India where technical knowledge is developed for their in-house needs. While the software sector has grown at a much faster pace than many other sectors in India up to now, in the near future, the advantages will quickly start spilling over to other industries and raise their productivity to new levels. The development and widespread use of telecom equipment, mobile communication technology, broadband, etc. will facilitate this spread.[10] For any industry trying to "learn," there is almost instant access to vast amounts of information, enhanced communication, and ability for dissemination. Compared with the last 20 years, the technological advances will be so much more nuanced in the next 20 years, and we will see that TFP growth in India will not just follow a similar path as any other economy, but can potentially leap forward to the frontier.

Positive spillovers from other physical infrastructure will also boost productivity of factors. The development of all such networks as well as the improvement in education and skills can lead not only to "catching up," but also to technological innovation, which will further raise TFP growth.

We conjecture, based on evidence in the literature, that TFP is driven by infrastructure, human capital, the spread of information and communications technology, and the globalization of firms, among other reasons. In the growth accounting framework, we do not directly measure TFP. It is measured indirectly as a residual in the production function—output growth that is not explained by the growth of other inputs (described further in the next section).

4. Estimating Trend GDP Growth

In this section, we estimate the trend growth of output per worker in the long run given the factor inputs of the economy and total factor productivity. This steady state measure of output growth is estimated using a production function approach. We first decompose output per worker growth in the last three decades into the contributions from the various inputs. We then make assumptions for the long run growth of these factors to estimate trend GDP growth rate from 2014–2030.

4.1 Decomposition of Output Growth

We use a simple accounting framework that decomposes output growth into the growth of factor inputs and the growth of TFP. Output (Y_t) is defined using a Cobb-Douglas production function with constant returns to scale featuring physical capital (K_t), infrastructure capital (X_t), human capital (h_t), labor (L_t), and TFP (A_t) as:

$$Y_t = A_t K_t^{\alpha} X_t^{\beta} (h_t L_t)^{\gamma} \qquad (1)$$

where α, β and γ represent the shares of capital, infrastructure capital, and quality adjusted labor in output, with the assumption of constant returns to scale.

In per worker terms,

$$y_t = A_t k_t^{\alpha} x_t^{\beta} h_t^{\gamma}. \qquad (2)$$

10 Fixed broadband internet subscribers increased from 50,000 in 2001 to 14 million in 2012 based on World Development Indicators. According to data published by the Telecom Regulatory Authority of India, the number of mobile subscribers increased from 8 .7 million in 2002 to 886 million in 2013.

The share of capital in output, α, is assumed to be 0.3, based on the estimate used in the literature. The output elasticity of infrastructure in a Cobb-Douglas production framework is obtained in cross-country studies in the range of 0.07–0.1. For South Asia, Sahoo and Dash (2012) argue that the elasticity is high, so we take the upper value of the cross-country range and set β, the share of infrastructure capital, as 0.1.[11] [12]

We use annual data for the period 1981–2013. Output is measured by real GDP at factor cost (million rupees, 2004–05 prices). For capital stock, we use the series on gross fixed capital formation and compute capital stock using the perpetual inventory method.[13] A series on employment is not available for India, hence, we use the working-age population (15–64) multiplied by the LFPR as a proxy for the employed labor force. All variables being divided by this measure can be thought of as per worker.[14]

We follow the literature to generate a measure of human capital stock. Data is obtained on the average number of years of schooling of the population in this age group from Barro and Lee (2012). We follow Bils and Klenlow (2000) who model human capital as a function of the average years of schooling of the working-age population (s):

$$h = exp\Psi(s) = exp\left(\frac{\Theta}{1-\Psi}s^{1-\Psi}\right) \qquad (3)$$

where, they estimate the parameters based on evidence regarding the Mincerian returns to schooling for a cross section of countries. Following Bils and Klenow (2000) we set ψ=0.58 and Θ=0.32.

For physical infrastructure, we use different indicators to represent the many dimensions, such as transport, telecommunications, and energy. Any single indicator is inadequate to provide a sense of the overall stock of infrastructure in the economy, and the use of a single indicator may give a misleading picture of the availability and contribution of infrastructure (Canning, 1999) (Calderón, Moral-Benito and Servén, 2011). The indicators we use are:

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11 Calderon, Moral-Benito, and Serven (2011) explain that since infrastructure capital appears in x and in k, the elasticity of output with respect to infrastructure capital can be approximated as $\Psi = \beta + \lambda\alpha$, where λ is the share of infrastructure capital in overall capital (value). For evaluating λ, data on the price of infrastructure is required, which is not easily available. However, they find this share is small, so Ψ is typically close to the estimate β.

12 As a robustness check, we use β=0.05 and β =0.2. Naturally for a smaller estimate of β, the contribution of infrastructure to overall growth is lower than for a higher estimate. However the main result does not change, that capital and TFP are key contributors to GDP growth especially in the last decade. Projected GDP per worker growth on average is also very similar in all cases. The results are shown in the Appendix.

13 Following Nehru and Dhareshwar (1993), for initial capital stock we use the steady-state relationship from the Solow growth model, as follows:

$$K_0 = \frac{I_0}{g+\delta}$$

where K_0 is the initial capital stock, g is the steady-state growth rate of investment and δ is the depreciation rate. We used the growth rate of investment at 5.2%, which is the average real GFCF growth in 1952–73, and assumed a depreciation rate of 5%.

14 The average rate of growth of the working-age population is 2.3% per annum, and of working-age population multiplied by LFPR is 1.9% from 1980–2013.

a) Roads (X_1): Highways (km),
b) Electricity (X_2): Electricity production (kWh), and
c) Telecommunications (X_3): Sum of the number of telephone lines and cellular mobile subscriptions.

To assess the role of infrastructure as a whole, we build an index summarizing the three indicators using principal component analysis. As with the other input factors, the variables are expressed in per-worker terms (where L is the working-age population multiplied by LFPR and in logs.[15] The infrastructure index can be expressed as:

$$x_t = 0.377 ln\left(\frac{X_1}{L}\right) + 0.318 ln\left(\frac{X_2}{L}\right) + 0.305 ln\left(\frac{X_3}{L}\right). \quad (4)$$

TFP is derived as:

$$A_t = \frac{y_t}{k_t^{\alpha} x_t^{\beta} h_t^{\gamma}} \quad (5)$$

Since it is a residual - the difference between output and inputs, TFP measures how factors are being used productively. But a disadvantage is that, it absorbs measurement errors associated with both sets of variables. While in theory, it is supposed to be neutral to the growth of inputs, in practice, if a higher weight is assigned to a faster growing factor of production, then the change in TFP is lowered arbitrarily.[16] This is an issue to keep in mind while interpreting the results of the analysis.

First, we analyze the sources of output growth from 1981–2013.[17] Using the data and Equation 2, we decompose GDP per worker growth as follows:

$$\hat{y}_t = \hat{A}_t + \alpha\hat{k}_t + \beta\hat{x}_t + \gamma\hat{h}_t \quad (6)$$

Such that changes in output per worker can be explained by changes in the factor inputs (denoting by $\hat{z}$ the growth rate of variable z)—physical capital and infrastructure per worker, human capital, and TFP. The decomposition of output growth averaged for three decades (from 1980–2013) is shown in Figure 9.[18]

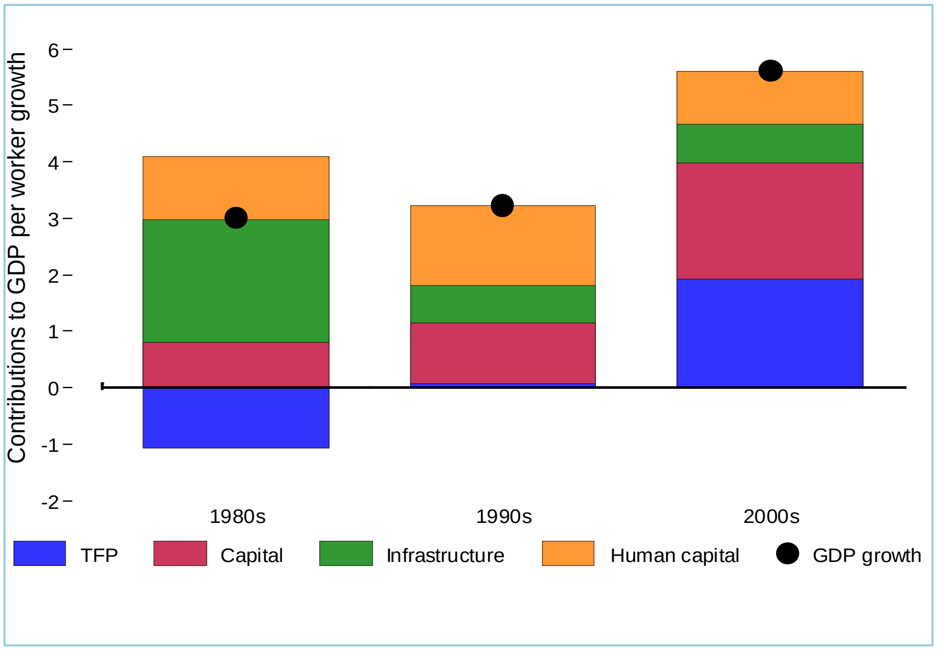
15 The first principal component accounts for 0.9% of the overall variance. The correlation between the first principal component and each indicator is above 0.9. For details on the principal component analysis, see Appendix Table A.3.

16 Bosworth, Collins, and Virmani (2006) discusses the difficulties in obtaining reliable estimates for factor shares in India, due to a large informal sector as well as a large proportion of self-employed individuals whose reported income cannot be separated into labor and capital income. However, they show that the choice of specific values for the shares has marginal impact on the estimation of TFP because, in general, they find relatively small differences in the growth rates of labor and capital inputs.

17 GDP data at constant prices series is available until 2013, and we construct capital stock data till 2013 using gross fixed capital formation. Average years of schooling from Barro and Lee (2012) are available in five year intervals and the missing data is interpolated. For infrastructure, data on electricity and phones are used till 2011, and the series is extended till 2013 using the average growth rate from 2000–11. Data on length of highways changes abruptly in the source; hence we use data till 2008, and then extend the series till 2013 using the average growth from 2000–2008.

18 The decade 2000s covers the period 2000–13.

Figure 9: Contributions to Gross Domestic Product per Worker Growth



GDP = gross domestic product, TFP = total factor productivity.
Source: Authors' calculations

Additions to capital per worker have always been important for growth, and its share in output per worker growth has been rising through the decades—from 0.8 percentage points in the 1980s to 1.1 percentage points in the 1990s, and further, to 2.1 percentage points in 2000s. In the 1980s, infrastructure capital per worker contributed a prominent 2.2 percentage points to output per worker growth. This followed from the increase in public investment in infrastructure during this period compared to the past years.

Table 3: Contributions to GDP per Worker Growth

	Percentage points				%
	TFP	**Capital**	**Infrastructure**	**Human capital**	**GDP**
1980s	-1.10	0.79	2.18	1.12	3.00
1990s	0.07	1.07	0.66	1.41	3.21
2000s	1.91	2.06	0.70	0.93	5.60

GDP = gross domestic product, **TFP** = total factor productivity.
Source: Author's calculations.

The share of human capital growth was also strong at 1.1 percentage points in this decade. In the 1990s and 2000s, infrastructure per worker contributed around 0.7 percentage points to growth and human capital around 1.4 and 0.9 percentage points respectively. A reason for the sizable differences from the 1980s to the next two decades was the drastic change in the role of TFP in output growth. TFP dragged down growth by 1.1 percentage points in the 1980s. The policy environment prior to 1980 had an adverse effect on the productivity of the economy, particularly in the industrial sector. However, post-reforms in the 1990s, which included trade and financial liberalization, and deregulation and delicensing in industry, the share of TFP growth in GDP per worker growth increased to 0.1 percentage points in the 1990s; and in the 2000s, TFP growth became a key driver of growth by contributing 1.9 percentage points.

India experienced strong growth during the period 2000–13, averaging 5.6 percent per year for GDP per worker, more than 2 percentage points higher than in the 1980s. In the last decade, along with the other factors, growth in TFP played a significant role.

4.2 Projections

We make baseline assumptions for the growth rate of the various factors using information where available and then based on our analysis of past trends (Table 4).

TABLE 4: Assumptions for Trend Growth Projections, 2014-2040

	Capital	Infrastructure	Quality adjusted labor	TFP
Baseline scenario	Average growth rate in 2000-2013 (8.51%).	Average growth rate in 2000-2011 for line and mobile subscribers (2.40% and 7.40%)and electricity production (6.20%); 2000-2008 average growth for length of highways (3.07%)	UN population projections for working-age population, Barro and Lee (2012) projections for average years of schooling (2010=6.59 years, 2030=8.95 years).	Average growth in 2000-2013. (3.55%).
Downside scenario: TFP	Same as baseline.	Same as baseline.	Same as baseline.	Average growth in 1990-2004 (2.62%).
Downside scenario: K	Average growth in 1990-2004. (5.95%).	Same as baseline.	Same as baseline.	Same as baseline.
Upside scenario: Higher school year	Same as baseline.	Same as baseline.	Assumed projected average years of schooling to increase by one year from 2014-2030.	Same as baseline.
Upside scenario: TFP	Same as baseline.	Same as baseline.	Same as baseline.	Average growth in 2006-2008. (5.27%).

K = capital stock, TFP = total factor productivity.
Source: National Accounts Statistics.

We use data on working-age population and LFPR projections from UN (2015). Projections on the average years of schooling used to compute human capital are available from the updated dataset of Barro and Lee (2012). We assume that capital stock, and TFP will grow at their 2000–13 annual rates. Infrastructure components also increase at their annual rates from

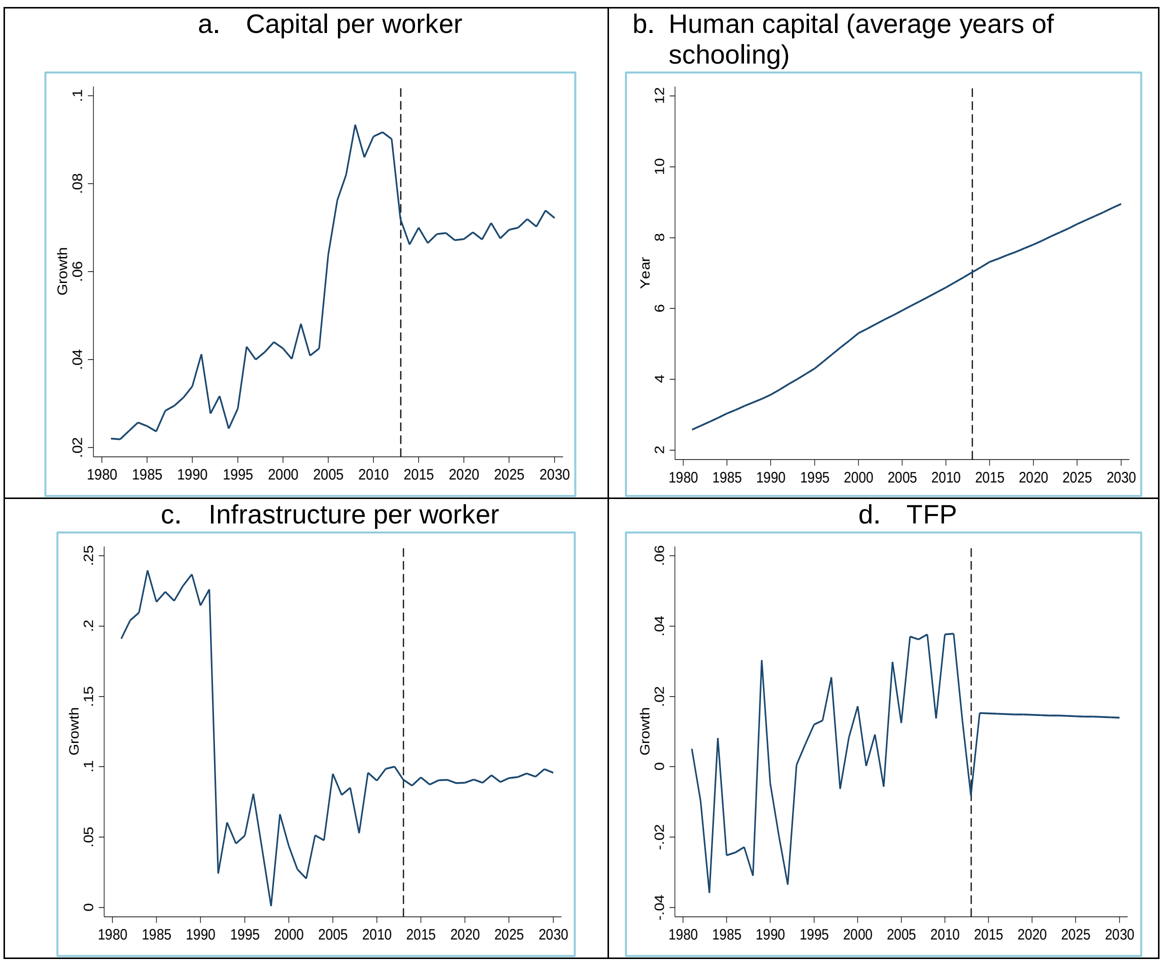
2000. According to these assumptions, in the baseline scenario, the economy is growing at the same pace as it has done for the past decade or so. Thus, all factors are growing gradually in the projection period and TFP is somewhat stable, which reflects a slight decline in TFP growth in the last few years post the global financial crisis (see Figure 10 for baseline projections).

We log and HP filter the individual series to extract the trend and then compute growth of the various factors. Using the following equation (where $\hat{x}^T$ denotes the growth rate of the trend of variable x):

$$\hat{y}_t{}^T = \hat{A}_t^T + \alpha\hat{k}_t^T + \beta\hat{x}_t^T + \gamma\hat{h}_t^T, \quad (7)$$

the trend growth of output per worker ($\hat{y}^T$) is computed. Since all input variables are assumed to grow in the projection period (2014–30), trend growth of GDP per worker is not declining either. It averages 6.5 percent in this period (and the growth rate of projected working-age population multiplied by LFPR is 1.2 percent).

Figure 10: Projected Growth of Factor Inputs



TFP = total factor productivity.

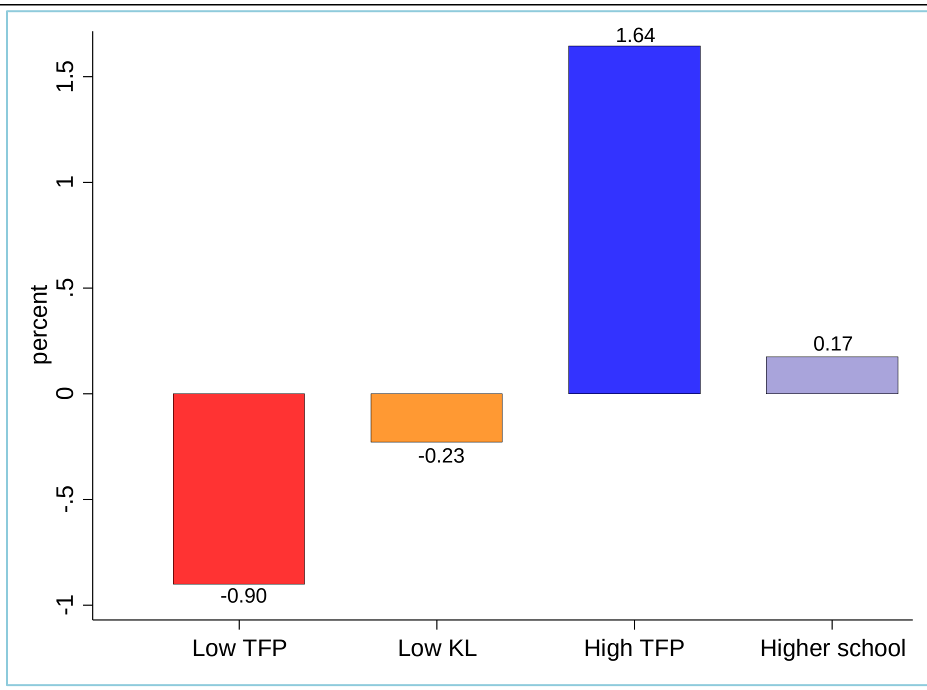
Source: Authors' calculations.

4.3 Alternative Scenarios

Two key contributors to growth in the recent past have been capital stock and TFP, and it can be expected that their performance will be crucial to growth going forward. We consider some alternative scenarios for the growth of these factors described in Table 4.

There are concerns that investment rates may be declining in India, for several reasons such as low private household, corporate and public savings, bottlenecks in factor markets, policy hurdles and so on (as discussed in Section III). Hence, the growth rate of capital stock could be negatively affected going forward compared to the last decade. We consider a downside scenario where capital stock is growing at a lower rate than considered in the baseline. So, instead of growing at the 2000–13 average annual rate of 8.5 percent, capital stock grows at the 1990–2004 average of 5.9 percent from 2014–30. All other factors continue to grow as in the baseline scenario. As can be seen in Figure 11 which plots deviations from baseline growth, lower capital stock growth (of 2.6 percentage points in this example) drags down average trend growth of output per worker by 0.23 percentage points.

Figure 11: Deviations from Baseline Trend Growth of Output per Worker of 6.3%, 2014-30



KL = capital stock per worker, LF = labor force, school = average number of school years, TFP= total factor productivity

Source: Authors' calculations.

Similarly we examine another downside scenario where TFP growth is lower than the baseline, based on the average growth in 1990–2004 (2.6 percent instead of 3.5 percent average for 2000–13). TFP growth has been declining in recent years post the global financial crisis and this could continue into the future. The effect on overall growth is sizable; a 0.9 percentage point drop in TFP growth reduces trend GDP per worker growth by 0.9 percentage points.

A comparison shows that the effect of slower TFP growth is much higher than the effect of slower capital stock accumulation. Thus if capital formation indeed decelerates in the future, the analysis suggests that TFP growth would need to be even higher to meet the baseline trend growth rates.

We consider an upside scenario where TFP growth rebounds to a higher average that was seen in the period 2006–08 (5.3%). A number of policy reforms can improve the TFP performance from its current levels such as improving infrastructure, financial market efficiency, increasing foreign direct investment, eliminating frictions in labor and land markets, simplifying taxation regulations and in general improving the business environment etc. Predictably, this raises trend GDP growth significantly, such that a 1.8 percentage point increase in TFP growth considered will raise average trend GDP per worker growth by 1.6 percentage points in the projection period.

Finally, we also consider the role of human capital in raising growth. The average number of years of schooling in India is quite low compared to other emerging economies, and advanced economies. For example in 2010, the number in India was 6.6 years compared to 13.2 years in the United States of America. According to projections by Barro and Lee (2012), the average years of schooling in India will increase to 8.9 in 2030. Suppose education expenditure in India accelerates so that there is an increase in this projected path in a way that every five years an additional year of schooling is achieved, so that by 2030 the number is 9.9. The increase implemented in this scenario would add 0.2 percentage points to trend growth compared to the baseline, thus stressing the importance of the role of human capital development in the economy.

5. Conclusion

In this paper, we analyze the sources of growth in the economy in the last three decades using a standard growth accounting framework, and find that capital stock and TFP are key contributors. The recent decline in investment by firms which will affect capital accumulation going forward has raised concerns about the long term growth of output in the economy. We argue that in general all factors of production, namely quality adjusted labor, infrastructure capital, non-infrastructure capital and TFP can continue to grow in the future, provided the policy environment supports both growth as well as efficient allocation of the available resources.

We also project the growth rate of trend GDP per worker by making assumptions about the growth of the various factors and discuss alternative scenarios to the baseline. Our projections suggest that the role of TFP remains crucial. If indeed capital stock does decelerate going forward, TFP growth should be even higher to achieve our baseline projection of 6.5% for trend growth of GDP per worker. Human capital and infrastructure growth are also important independently and for their role in boosting TFP.

While a number of domestic and external cyclical factors were a drag on investment activity in the economy post the financial crisis, particularly with continuing weak global conditions more recently, the role of domestic structural reforms to strengthen the supply of factors of production assumes greater importance.

APPENDICES

A. Data

Table A.1: Descriptive Statistics (1980–2010)

	Mean	SD	Min	Max	Unit
GDP growth	3.36	2.94	-7.75	7.33	percent
Capital growth	3.98	1.79	2.05	8.35	percent
Electricity production	0.72	0.27	0.30	1.22	thousand kWh
Telephone lines	0.12	0.23	0.01	0.99	number
Length of highway	0.002	0.001	0.000	0.003	km
Average years of schooling	4.44	1.32	2.46	6.59	years

GDP = gross domestic product, kWh = kilowatt-hour, SD = standard deviation.

Note: All variables are in per worker terms except human capital which is per person.
Source: Described in Table A.2.

Table A.2: Data Sources

Indicator	Variable		Source
Gross domestic product	GDP at factor cost (2004–05 prices)		NAS
Investment	Gross Fixed Capital Formation		NAS
Highways	Length of Highways	CEIC	
Electricity	Electricity production		WDI
Telephone	Telephone and mobile subscriptions		WDI
Working-Age Population	Working-Age Population, both sexes		UN
Labor Rate Participation Rate	Labor Rate Participation Rate, both sexes		UN
Schooling	Average years of schooling	Barro and Lee (2012)	
Gross Domestic Savings	Gross Domestic Savings	CEIC	
Investment projects	Projects under implementation and commissioned		CMIE
Infrastructure	Metro lines and length of highways		CMIE

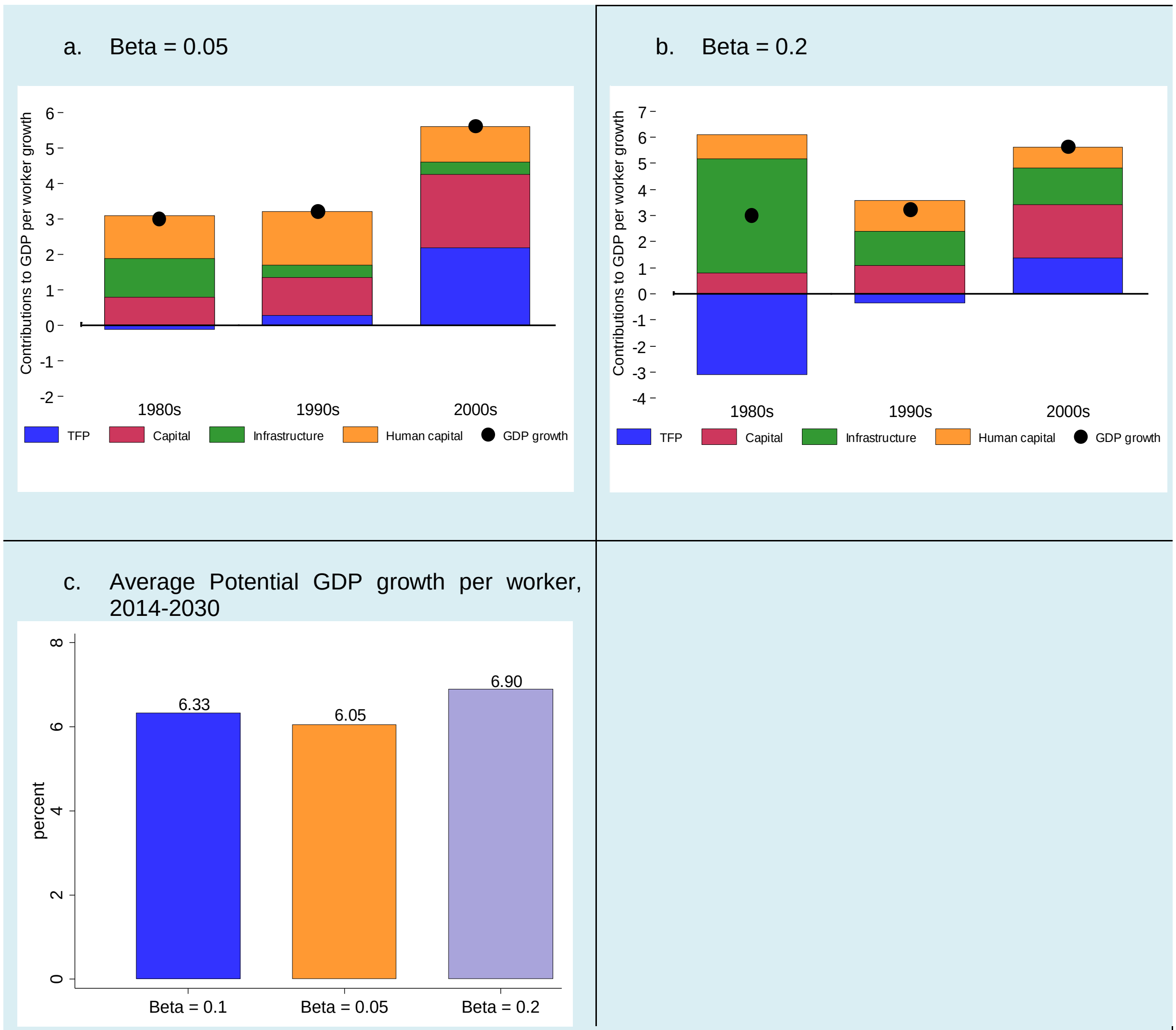
GDP = gross domestic product, CEIC = CEIC Data Company, CMIE = Centre for Monitoring Indian Economy Pvt. Ltd., NAS = National Accounts Statistics, WDI = World Development Indicators, UN = United Nations.

Table A.3: Principal Component Analysis

Indicator	Eigenvalue	Proportion explained		Weights (1^{st} comp)	Correlation with index
Comp 1	2.649	0.883	Electricity	0.377	0.998
Comp 2	0.347	0.116	Telephone	0.318	0.923
Comp 3	0.003	0.001	Highway	0.305	0.895

Source: Authors' calculations.

Figure A.1: TFP Scenarios with Different Infrastructure Index Weights



GDP = gross domestic product, TFP= total factor productivity

.

Source: Authors' calculations

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