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India's Rising Growth Potential

- India's high growth rate since 2003 represents a structural increase rather than simply a cyclical upturn. We project India's potential or sustainable growth rate at about 8% until 2020.
- The recent growth spurt was achieved primarily through a surge in productivity, which we believe can be sustained.
- India is well-positioned to reap the benefits of favorable demographics, including an 'urbanization bonus', and a further rise in capital accumulation, in part from an upsurge in foreign direct investment.
- The risks to growth are: political risk, including a rise in protectionism; supply-side constraints, including business climate, education, and labor market reforms; and environmental degradation.
- Our assessment suggests that India's influence on the world economy will be bigger and quicker than implied in our previously published BRICs research.

The authors would like to thank Jim O'Neill, Willem Buiter, and Sun-Bae Kim for their insightful advice and support. Thanks also to Dominic Wilson, Michael Buchanan, and Andrew Tilton for their comments on an earlier draft.

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January 22, 2007

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Summary

- **India's growth acceleration since 2003 represents a structural increase rather than simply a cyclical upturn**. Productivity growth is driving the increase, and explains nearly half of overall growth. We expect productivity growth to continue over the medium term; thus, we project India's potential or sustainable growth rate at about 8% until 2020. The implication is that India's contribution to world growth will be even greater (and faster) than implied in our previous BRICs research.

- **A turnaround in manufacturing productivity has been central to the ratcheting up of productivity growth**. The private sector was the principal driver of this turnaround, as it improved efficiency in the face of increased competition due to the cumulative effects of a decade of reforms. The underlying reasons are: increased openness to trade, investment in information and communication technology, and greater financial deepening. These factors still have some distance to run.

- **We estimate that the movement of surplus labor away from low-productivity agriculture to high-productivity industry and services contributes about 1 percentage point to annual GDP growth**. Productivity in industry and services is more than 4 times that in agriculture, which employs nearly 60% of the labor force.

- **India is well-positioned to reap the benefits of favorable demographics**, including an 'urbanization bonus,' over the long term due to the continued movement of labor from rural agriculture to urban industry and services. India has 10 of the 30 fastest-growing urban areas in the world and, based on current trends, we estimate a massive 700 million people (roughly equivalent to the entire current population of Europe) will move to cities by 2050. This will have significant implications for demand for urban infrastructure, real estate, and services.

- **Investment in highways** (especially the Golden Quadrilateral Highway project linking the 4 major cities of Delhi, Mumbai, Kolkata, and Chennai) is expected to reduce travel times by half, help ease congestion in cities, attract activity and increase productivity.

- **India's potential growth rates could increase further**, given sustained productivity growth and favorable demographics, if it can significantly increase capital accumulation. We estimate that India would need to boost its investment rate by another 16% of GDP to achieve and sustain a growth rate of 10%.

- **The key threats to the growth process** are from political risks, supply-side constraints to doing business, lack of education, and environmental degradation.

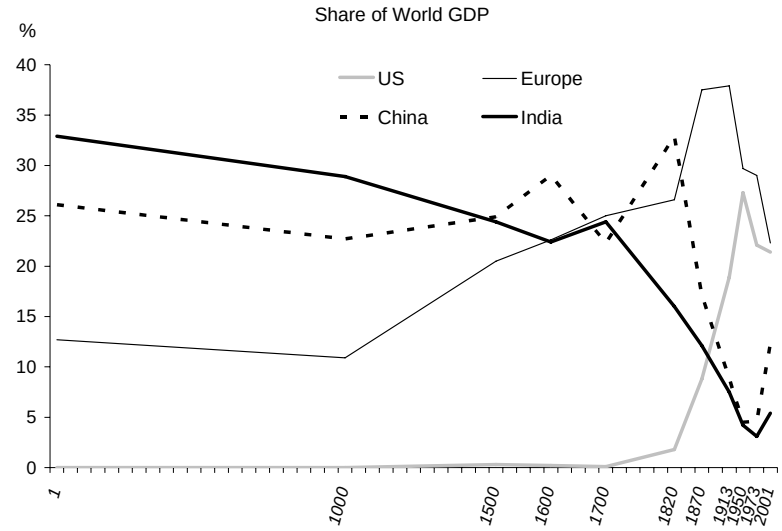
- **Our projections of India's potential growth are based on growth-friendly policies continuing**. In particular, policies to enhance Financial sector growth, Openness to trade, Rural-urban migration, Capital formation, Education, and Environment, which we call the 'FORCE' factors will be critical to sustaining growth.

I. The scope for catch-up

On the eve of the industrial revolution (around 1770), India was the second-largest economy in the world, contributing more than 20% of total world output. By the 1970s, after 2 centuries of relative economic stagnation, that share had fallen to 3%—the lowest in its recorded history. From a long-term perspective, the post-industrial economic decline of India (and China) is a historical aberration, driven to some extent by a lack of openness. After independence in 1947, India followed inward-looking and state-interventionist policies that shackled the economy through regulations and severely restricted trade and economic freedom. The result was decades of low growth termed pejoratively the 'Hindu rate of growth.' Reforms beginning in 1991 gradually removed obstacles to economic freedom, and India has begun to play catch-up, steadily re-integrating into the global economy.

Since 2003, India has been one of the fastest-growing major economies, leading to rapid increases in per capita income, demand, and integration with the global economy. Will India be able to sustain, or even increase, its high growth rates over the medium term? If so, what will the implications of India's re-integration into the global economy be for world demand growth?

Exhibit 1: A historical perspective



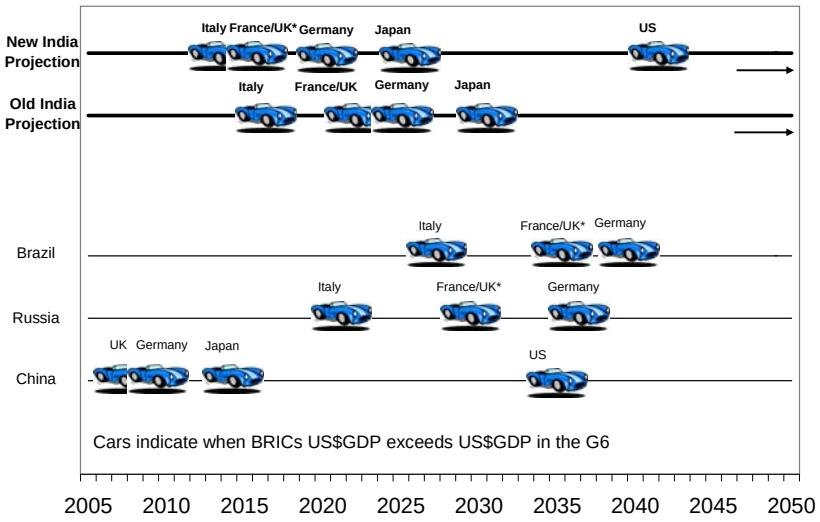
Source: Angus Maddison, *The World Economy*: Historical Statistics, OECD 2003.

We argue that there has been a structural increase in India's potential growth rate since 2003 on the back of high productivity growth.[1] In this paper, we explain why productivity has surged and why we think it is likely to continue over the next decade.

[1] Productivity is essentially the manner in which inputs are combined to produce more output. In this paper, by productivity we mean total factor productivity (TFP), or the manner in which all inputs are combined to achieve more output.

Our baseline projections for India's potential output growth show that the economy can sustain growth rates of about 8% till 2020, significantly higher than the 5.7% that we projected in our original BRICs paper.[2] The key underlying assumption is that growth-supportive policies will continue to be implemented. The implications of this are that India will overtake the G6 economies faster than envisaged in our earlier BRICs research. Indeed, India's GDP (in US$ terms) will surpass that of the US before 2050, to make it the second largest economy. India's contribution to world growth will also be high and increasing.

Exhibit 2: When will India's US$ GDP exceed that of the G6?



Note 1: India's US$ GDP is projected to exceed that of the UK a year after it surpasses France in both our old and new forecasts.

Note 2: Our new projections for India's potential growth envisage an average growth of 6.9% in 2006-2050. We also assumed the same exchange rate changes till 2050 as in the original BRICs projections. Under the original BRICs projection, India would become the third largest economy by 2050.

Source: CEIC, Goldman Sachs Research estimates.

The higher growth rate under our new projections will have large implications for demand in India. From 2007 to 2020, India's GDP per capita in US$ terms will quadruple (a third higher than the original BRICs projections). Indians will also consume about 5 times more cars and 3 times more crude oil.[3]

Comparisons with other countries that have experienced similar rapid rates of growth show that India is firmly on the growth expressway. There is considerable scope for catch-up and, even with our baseline projection, the speed of India's growth transition is not implausible when compared to the growth experiences of other East Asian countries.

A turnaround in manufacturing productivity since 2003 has been crucial. The proximate cause is the increase in efficiency of private-sector firms in the face of growing competition. The gradual opening up of the economy introduced a competitive dynamic, which forced the private sector to restructure during the relative slowdown in growth and corporate profitability during 1997-2002. After the restructuring, the private sector emerged leaner, fitter, and more productive.

[2] See Dominic Wilson and Roopa Purushothaman, *Dreaming with BRICs: The Path to 2050*, Global Economics Paper No. 99, October 1, 2003.

[3] Our original BRICs projections had Indians consuming 3.5 times more cars and 2.3 times more crude oil from 2007-20.

The underlying causes for the increase in efficiency of private firms have been trend accelerations in international trade, financial sector growth, and investments in and adoption of information and communication technology. These are also the cumulative effects of a decade of reforms.

The re-allocation of land, capital, and especially labor from low-productivity agriculture to high-productivity industry and services is an essential dynamic behind sustained productivity growth. This process is being accelerated by higher returns in industry and services due to trade openness, cheaper credit, investments in IT and communications, and the building of highways. These processes are in their initial stages and have substantial distance left to run.

The upside to our baseline projections is significant. Thus far, the economy has logged high growth rates without significant increases in domestic or foreign direct investment. If it can accumulate significantly more capital to add to its favorable demographics and ongoing productivity gains, India could reach a growth rate of 10% by 2010 and sustain it thereafter. We show various combinations of factors that are necessary to achieve this.

The downside risks to our baseline growth projections come from a slowdown or reversal in reforms in part due to political/social instability, supply-side constraints to doing business that include shortfalls in educational attainment, and environmental degradation.

Based on our analysis, we would emphasize the 'FORCE' factors as critical to sustaining growth: Financial deepening, Openness to trade, Rural to urban migration, Capital deepening, and Education and Environment.

II. Productivity accelerates

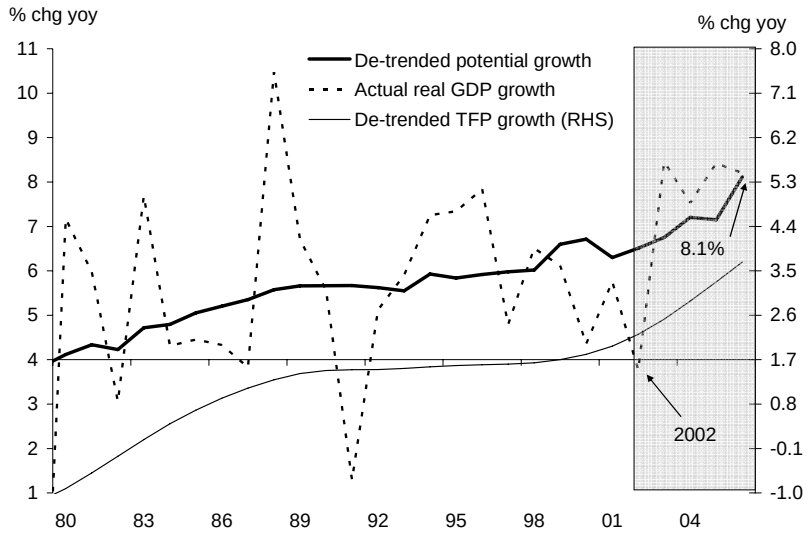
India's growth performance since independence in 1947 has been well below potential, stymied by low productivity. From 1960 to 2000, annual total factor productivity (TFP) growth averaged a mere 0.25%. Tentative steps to reform the economy in 1985, and then fundamental reforms since 1991, moved the economy up a gear, with growth averaging 6% and TFP growth moving up to an average of 1.6% a year.

To estimate the productive capacity of India's economy and understand its sources of growth, we used a supply-side approach distinguishing between contributions of TFP and of inputs of capital, labor, and human capital, to obtain the underlying 'potential' or trend growth rate. By measuring the 'potential,' we seek to estimate the rate at which the economy can grow without 'overheating' or igniting inflation. This rate is useful as it provides a benchmark with which to assess actual growth outcomes.

We first stripped out all cyclical variations in inputs to calculate the trend. We then cyclically adjusted productivity growth to obtain the trend (for more details on our estimation of India's potential output growth, please refer to Appendix I).

We find that, since 2003, there has been a structural increase in India's potential growth to nearly 8% from 5%-6% in the previous 2 decades. Productivity growth has been the key driver behind the jump in GDP growth, contributing to nearly half of overall growth since 2003, compared with a contribution of roughly one-quarter in the 1980s and 1990s.

Exhibit 3: An acceleration of potential growth and productivity

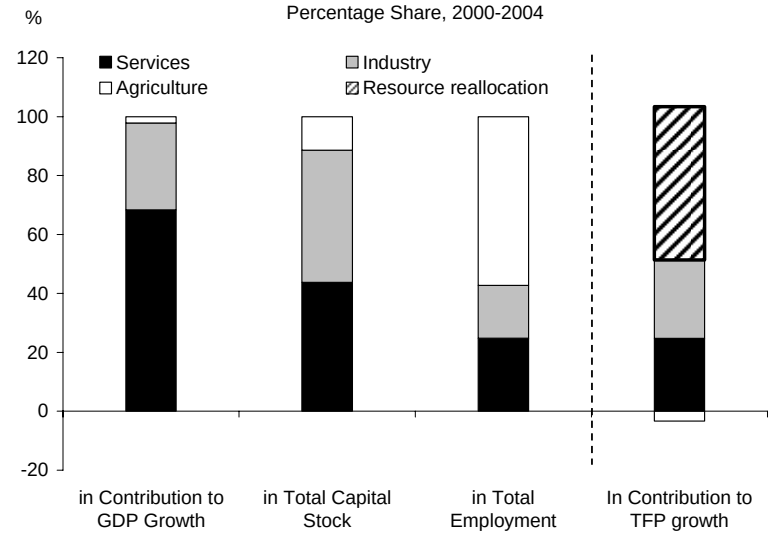


Source: CEIC, Goldman Sachs Economic Research.

The growth drivers: Services and industry

We then sub-divided growth into the key sectors of agriculture, industry and services. Industry is increasingly becoming an important growth driver, contrary to conventional wisdom that growth in India is only services-led. Indeed, a quarter of services are directly linked to industry, in sectors such as trade, transport, electricity, and construction.

Exhibit 4: While industry and services are the engines of growth and productivity gains, their share of employment is small



Source: Central Statistical Organization of India, Goldman Sachs Economic Research.

Recent increases in productivity are in part due to a turnaround in industry productivity, which has rebounded from negative to positive (see Exhibit 5 on the next page). Services productivity has remained strong over the past few decades. Labor has moved into industry from agriculture, while capital has moved to services since 2002.

Exhibit 5: Looking at the sectors more closely—industry turns around

Average growth (% chg yoy)

	GDP	TFP	Capital Stock	Employment	Education Attainment
Agriculture					
1981-1990	3.5	0.5	2.1	1.1	2.3
1992-1996	4.7	1.8	2.0	1.2	2.0
1997-2001	2.0	-0.4	1.3	0.6	2.3
2002-2004	1.3	-1.0	1.5	0.4	2.2
Industry					
1981-1990	7.0	0.5	7.5	3.4	2.3
1992-1996	7.3	1.2	9.0	2.0	2.0
1997-2001	**4.5**	**-1.2**	5.4	3.7	2.3
2002-2004	**7.7**	**1.9**	3.9	4.7	2.2
Services					
1981-1990	6.7	1.6	3.3	3.5	2.3
1992-1996	7.5	2.2	4.7	3.2	2.0
1997-2001	8.2	2.8	4.2	3.3	2.3
2002-2004	8.5	3.0	5.8	2.8	2.2

Source: Central Statistical Organization of India, Goldman Sachs Economic Research.

In India, labor is nearly 4 times more productive in industry and 6 times more productive in services than in agriculture, where there is a surplus of labor. Indeed, economic theory tells us that as labor moves from low-productivity sectors such as agriculture to high-productivity sectors such as industry or services, overall output must improve.[4]

We estimated the output gains due to labor migration from agriculture to services and industry, and found that in recent years, this move has contributed upwards of 0.9 percentage point (pp) to overall growth.[5] The gains are roughly equally split between agricultural laborers moving to industry and to services.

Given that the movement from agriculture to other sectors (which in India's case is roughly equivalent to the move from rural to urban areas) is still in its initial phase, we expect the gains to increase and continue for several decades. Indeed, agriculture still employs close to 60% of the labor force with negative marginal productivity.

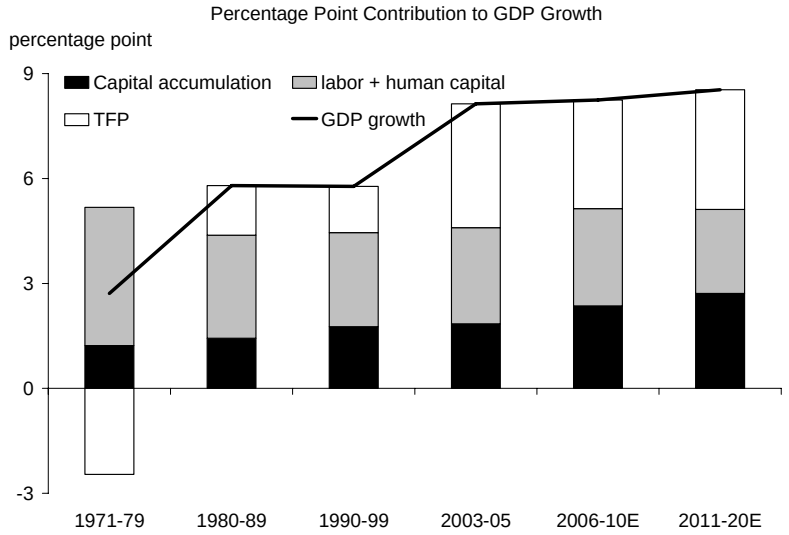
[4] After the famous Lewis model (1954), which established the notion of gains to labor productivity in both sectors due to the movement of surplus labor from agriculture to industry.

[5] The gain is relatively small as migration is still in its initial stages (see Appendix II, section II for detailed calculations). Bosworth, Collins and Virmani (2006) also find that the residual from estimating aggregate TFP and summing the TFP of sectoral production functions, i.e., gains from the re-allocation of all factors (labor, land and capital), is about 1.2% of GDP.

III. Our baseline projections

Based on our supply-side framework, we projected potential growth rates for India till 2020. Exhibit 6 shows our projections for the overall growth rate, and contributions from productivity, capital, labor and education. Keeping current rates of savings and investment roughly constant, we project India's potential growth rate at an average of 8.4% till 2020, on the back of continued productivity growth, favorable demographic factors, and further growth in educational attainment.

Exhibit 6: India: Geared up for higher potential growth



Source: CEIC, Goldman Sachs Economic Research.

Our baseline scenario is derived from fairly conservative assumptions:

- The investment/GDP ratio is assumed to remain roughly constant at around 29% of GDP.[6]

- The growth rate in average years of schooling is assumed to decline gradually in line with trend. This means an increase in average years of schooling from 5.8 in 2006 to 7.3 by 2020.

- For the labor input, according to demographic trends, over 100 million people will enter the labor force by 2020. We assume no increases in labor force participation rates[7] and that the rate of unemployment stays at its natural rate.[8]

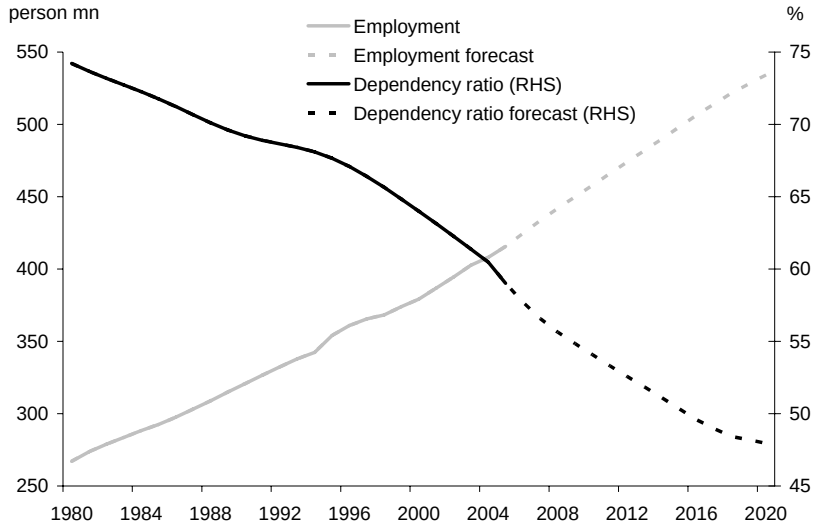
[6] Investment/GDP is measured in real terms.

[7] If participation rates were to increase by a quarter of a percent each year from the current rates of 61%, it would add another 25 million to the labor force in the next 10 years.

[8] Average unemployment rate during 1977-2005, which is 4.4%.

- For TFP growth, we assume an average annual rate of 3.3%. We think this is a reasonable assumption based on the large scope for catch-up, the continued movement of labor and land from agriculture to other sectors, aided by continued openness to trade, financial deepening, investments in information and communication technology, and the building of highways. These are discussed at length in Section IV below.

Exhibit 7: Favorable demographics: Employment to rise and dependency ratio to fall

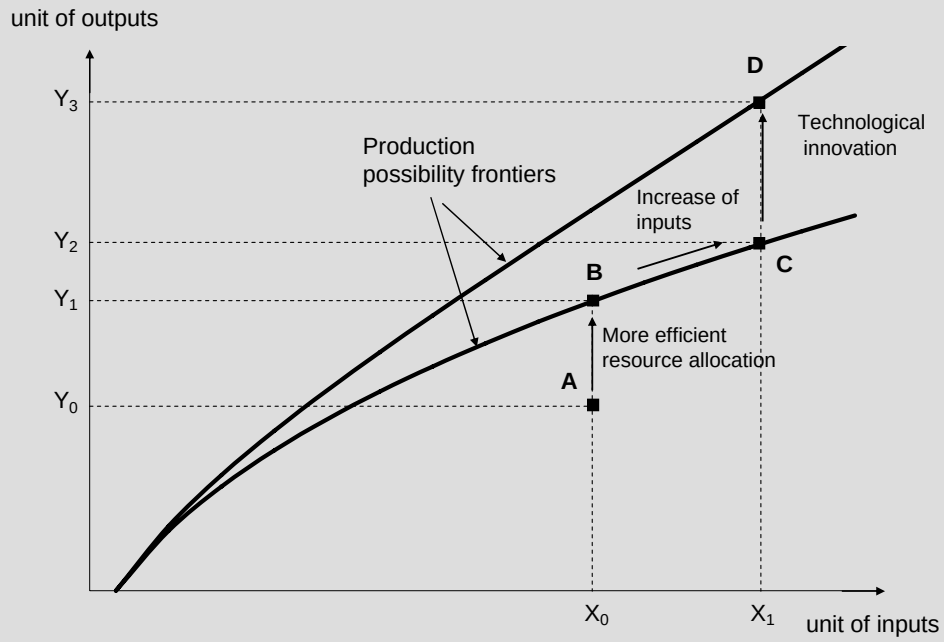


Source: UN, World Development Indicators, Goldman Sachs Economic Research.

Box 1: What will it take to reach 10% growth?

India's current growth rates of around 8% have been achieved without large increases in domestic capital accumulation or foreign direct investment, raising the possibility that increases in investment could boost growth futher.[8] As Exhibit B1 illustrates, India is well below its efficiency or productivity frontier. The curve represents all optimal points of combining inputs into output, i.e., the 'production possibilities frontier.' Currently, India is at point A (i.e., inside its optimal productivity frontier) due to inefficiencies in production.[9] Elimination of inefficiencies, or higher productivity growth, would lead it to point B. If it can increase its input of capital, it could move to point C with higher output. Continued catch-up due to technological innovation would lead the curve to expand outwards, thus increasing growth output.

Exhibit B1: Production function and the sources of growth



Source: Goldman Sachs Economic Research.

To determine the amount of investment required to reach 10% growth, we mapped out 2 scenarios based on different productivity growth rates. We assume productivity growth to be sustained at an average rate of either 3% or 3.5% till 2020. For the labor and education input we use the same assumptions as the baseline. Based on these assumptions, we calculated the real investment/GDP ratio required to reach and sustain 10% growth until 2020.

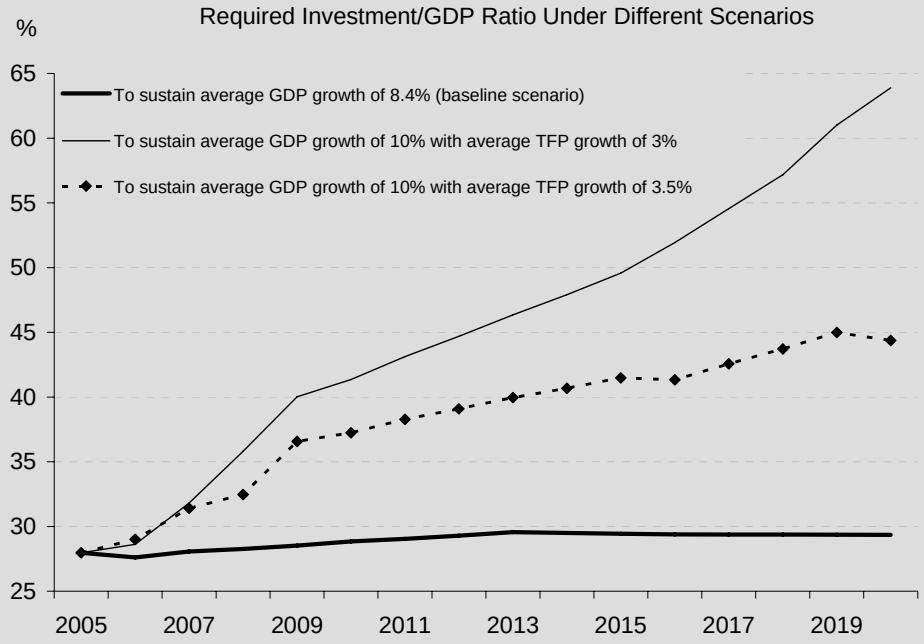
As Exhibit B2 shows, if we assume more optimistically that productivity growth is sustained at 3.5%, the required increase in investment/GDP ratio is of the order of 16%. Thus, India would have to boost its savings rate by roughly 16% of GDP, through a combination of domestic and foreign savings, in order to finance the investment required for a sustained 10% growth. Below we assess whether this is feasible. If productivity growth were to decline to 3%, then 10% growth is unsustainable. The large difference in required investment in the two scenarios is due to cumulative effects: a higher capital stock requires still higher investment to compensate for depreciation effects.

[8] It can be argued that India is far below its steady state capital per capita level. See Exhibit 14 on page 20.

[9] See Rodrik, Subramanian and Trebbi (2002), who estimate that India's TFP level is between one-third and 40% of what it should be given its institutions and geography.

Box 1 continued

Exhibit B2: Required investment/GDP ratio to sustain 10% growth versus the baseline scenario



Source: Central Statistical Organization of India, Goldman Sachs Economic Research.

How much of a constraint is India's savings rate?

India's savings rate is low compared with its East Asian neighbors, and raises concerns that the domestic savings constraint may not allow the kind of investment rates needed for high growth. Therefore, our baseline projections assume roughly constant investment/GDP rates, thus obviating the need for a rising savings rate.

Savings rates, however, tend to increase with falling dependency ratios, rising incomes, and greater financial sector development. We projected savings rates based on the evolution of dependency ratios. In India, according to our estimates, savings tend to increase about 0.8% for every 1% fall in dependency.[10] We assume these rates for our projections (see Exhibit B3).[11]

For our more optimistic scenario, with productivity growth averaging 3.5%, Exhibit B4 shows the required investment/GDP ratio, the savings rate projections, and the consequent current account deficit required to sustain a 10% rate of growth. We find that the current account deficit would have to be large and increasing, averaging 5.7% from 2006-2020. We believe such a large deficit would be difficult to sustain.[12] Hence, India would need to increase public savings substantially to sustain a 10% rate of growth.

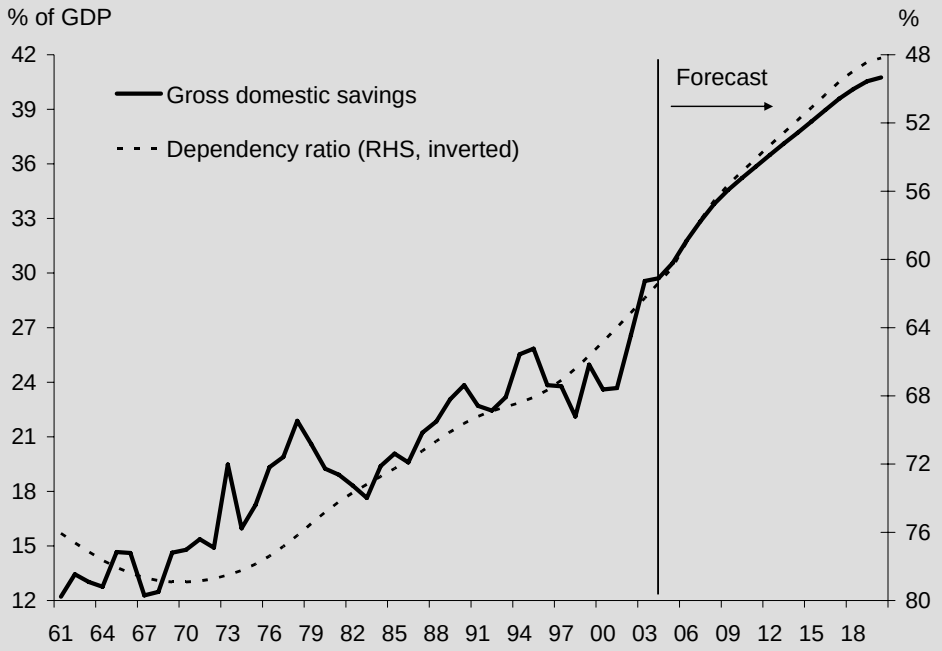
[10] Based on a simple linear regression of lagged domestic savings on dependency ratios for the period 1960-2004.

[11] These estimates are lower than an elasticity of 1 assumed by Rodrik and Subramanian (2004).

[12] According to IMF estimates, the external debt-stabilizing non-interest sustainable current account in India is -2.6% of GDP, although based on lower real GDP growth projections of 6.5%.

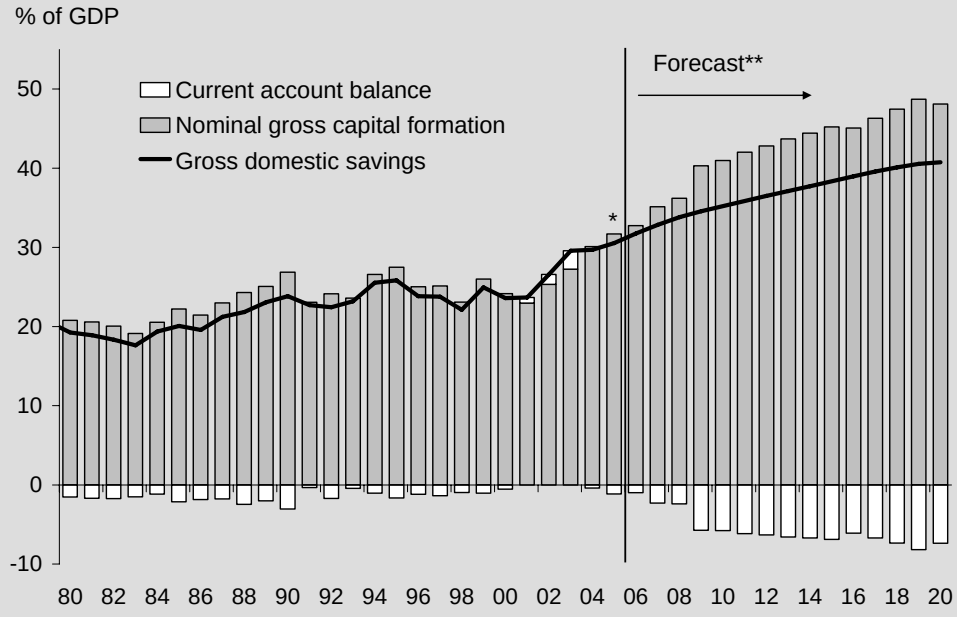
Box 1 continued

Exhibit B3: Savings rate is set to rise on falling dependency ratio....



Source: World Development Indicators, UN, Goldman Sachs Economic Research.

Exhibit B4: ...but not likely to be enough to sustain a 10% growth



* 2005 Investment rate is IMF estimate of 31.7%.

** Projection of implied gross capital formation to GDP ratio based on 10% GDP growth and 3.5% average TFP growth.

Source: World Development Indicators, CEIC, UN, Goldman Sachs Economic Research.

IV. Why productivity growth is likely to be sustained

The proximate cause of the increase in productivity since 2003 is the increased efficiency of private-sector firms in the face of growing competition. The gradual liberalization of the economy introduced a competitive dynamic, which forced the private sector to restructure during the relative slowdown in growth and corporate profitability during 1997-2002. After the restructuring, the private sector emerged leaner, fitter, and more productive. The presence of constraints, such as the lack of adequate infrastructure and a set of demanding, value-conscious consumers, forced companies to innovate on products, processes and distribution which, in turn, created companies that are more efficient and competitive.

In our view, the underlying causes for the increase in efficiency of private firms have been trend acceleration in international trade, financial deepening, and investments in and adoption of information and communication technology. The process that tentatively began after the onset of reforms in 1991, is also the cumulative effect of a decade of liberalization, a vital component of which included the gradual deregulation and de-licensing of industry.

Reason #1: India opens up

After the onset of reforms in 1991, India began to unshackle its closed economy by gradually lowering its very high trade barriers and boosting exports. Average tariffs have fallen to below 15% from as high as 200% as India began to re-integrate with the global economy. The impact of opening up has been significant. Exports have risen 14 times as India has rapidly gained trade share. This development has been most evident in the past 3 years, when trade has grown, on average, 25% a year.

Increased openness has contributed significantly to increasing productivity[13]:

- It provided access to superior inputs, ideas, and technology to domestic firms.

- The increased competition from actual and perceived imports has focused domestic firms on the need to improve efficiency as critical to survival.

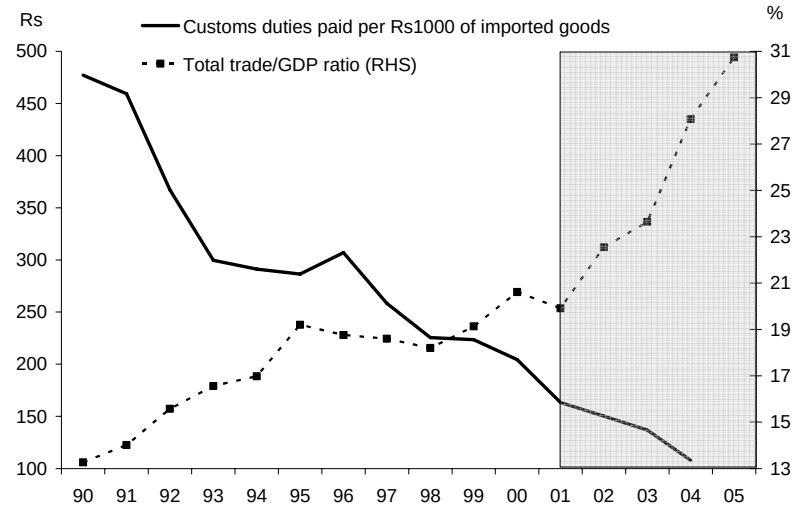
- It has rewarded the most efficient firms by way of access to foreign markets and larger gains, while penalizing the most inefficient domestic firms, thereby improving average productivity.

- It also encouraged a shift in employment from the less productive agricultural sector to more productive sectors.

India's trade/GDP ratio is still small, while average tariffs are still high by regional standards. India currently contributes less than 1% of world trade. Assuming that trade barriers continue declining, productivity gains from further trade integration still has some distance to run.

[13] Topalova (2004) provides evidence that the reduction in trade barriers in India has led to higher growth in firm productivity. Also see Poddar (2004) on the impact of competition in boosting productivity and export growth.

Exhibit 8: International trade has boomed as tariffs have come down

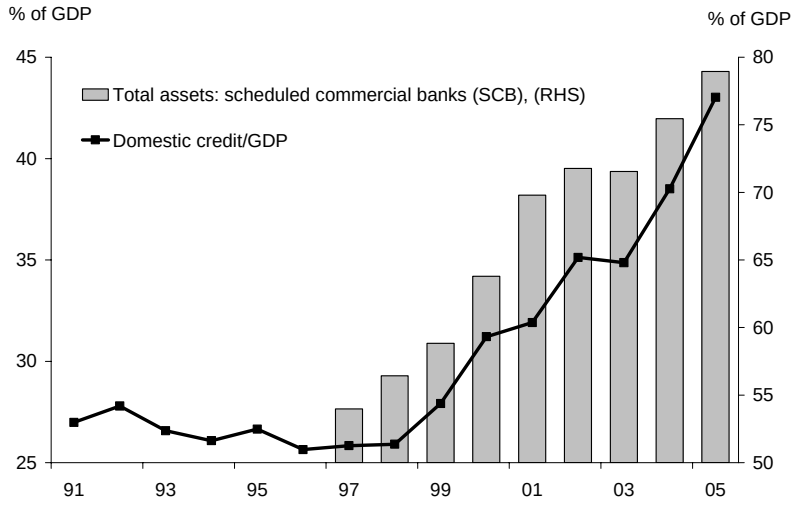


Source: World Development Indicators, Goldman Sachs Economic Research.

Reason #2: The rise of the financial sector

Starting from a low base, the financial sector has grown rapidly in the past decade, and especially in the past 4 years, and has contributed to the jump in productivity. Credit to the private sector has grown by an average of 32% over the past 2 years. Increased financial intermediation improves resource allocation by effectively channeling savings into investment and raising productivity.[14] India's financial sector is still relatively small compared with the size of its economy, as well as its East Asian neighbors. Assuming that policies to open up the financial sector remain on track, including the entry of foreign banks starting from 2009, we expect financial deepening to continue and to contribute to increases in productivity in the medium term.

Exhibit 9: Rapid financial deepening



Note: data for total SCB assets is only available from 1997 onwards.
Source: CEIC.

[14] See Levine (2004) for a survey on the impact of and the channels through which finance affects growth.

Reason #3: Back-office to the world

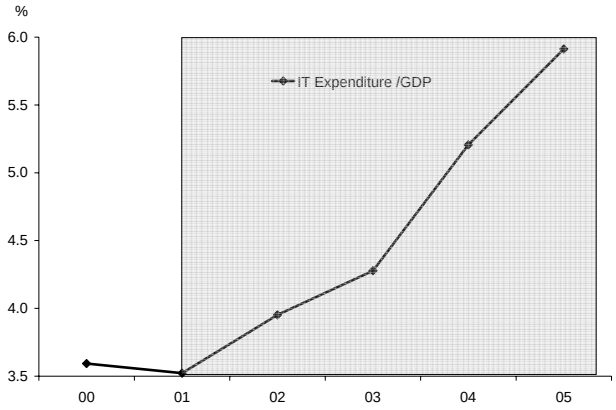
The success of the IT industry in India has had a material impact on productivity. Apart from the direct productivity gains of the major IT firms, it has had spillover benefits through 2 channels:

- It has provided powerful incentives for students to invest in IT skills. This has created a pool of technology-skilled labor that firms in other industries could tap into.

- It has had a demonstration effect on other domestic firms, which also ramped up their technology spending, thereby boosting productivity.

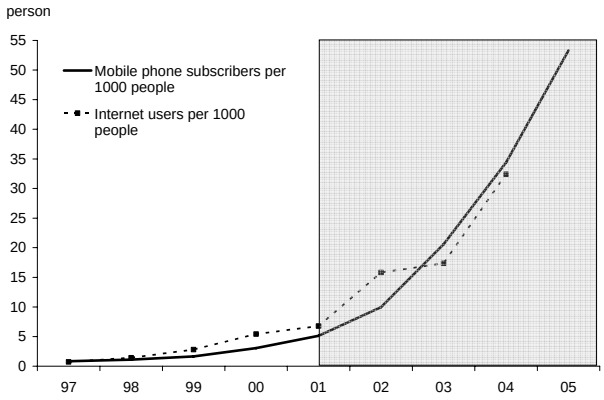
The rapid spread of mobile phones from a very low base provided a fillip to communications, further boosting productivity. Today, India is the fastest-growing market for mobile phones, with average growth rates of over 80% every year since 2000. As we show in Box 2 on page 22, India's technology spending is still low and there remains substantial scope for catch-up and productivity gains.

Exhibit 10A: IT spending is surging…



Source: World Development Indicators.

Exhibit 10B: …and internet & cell phone penetration is gathering speed



Source: CEIC, World Development Indicators.

Reason #4: The Golden Quadrilateral

The Golden Quadrilateral Highway project is the first part of India's most ambitious infrastructure project since the building of the railway network by the British in the 19th century. The highway aims to connect its 4 largest cities: Delhi in the north with Kolkata in the east, Chennai in the south, and Mumbai in the west. Along the way it runs through 13 states and 17 other cities with a million or more inhabitants, and it is expected to be fully functional by 2007.[15] The effort echoes the US' construction of its national highway system in the 1920s and 1950s, which fuelled commerce and development, and created the suburbs.[16]

We expect the new highways to help jump-start India's competitiveness, given that its dismal infrastructure has inhibited growth. They are expected to reduce travel times by half, lower fuel costs and freight delivery times, and enable firms to leverage economies of scale. We expect the arteries to attract economic activity along the way. Already, hotels, gas stations, and shops are sprouting up along the highways. This will have implications for real estate, for location of industry, and for decongestion of crowded cities. Areas close to urban centers stand to benefit most, as activity and people fan out of crowded cities along the highways.

More importantly, the highways will open up, and out, the closed worlds of India's villages. They will facilitate increased rural-urban migration, and when migrants return to their villages, they bring back new views and aspirations, encouraging others to follow in their footsteps.

The process is unlikely to be smooth or to happen overnight. Motorists could strike against taxes and tolls, speeding cars may have to contend with animals and bullock carts on the roads, local sensitivities to religious structures in the path of the highways may have to be taken into account, and there could be difficulties with the rural poor adapting to the highways. However, the potential for productivity gains and the boost to the economy are substantial.

Exhibit 11: Map of the Golden Quadrilateral Highway – Connecting India

Source: Goldman Sachs Economic Research.

[15] In the last 50 years, the government has built just 334 miles of 4-lane roads. The Golden Quadrilateral aims to build 3,625 miles of 4- and 6-lane highways. Construction has also begun for a North-South and East-West corridor which will further connect the country.

[16] Studies assessing the contribution of the inter-state highways to annual productivity of private industry in the US have estimated gains as high as 30% during the 1950s and 25% during the 1960s. See Nadiri and Mamuneas (1998).

Reason #5: The great migration

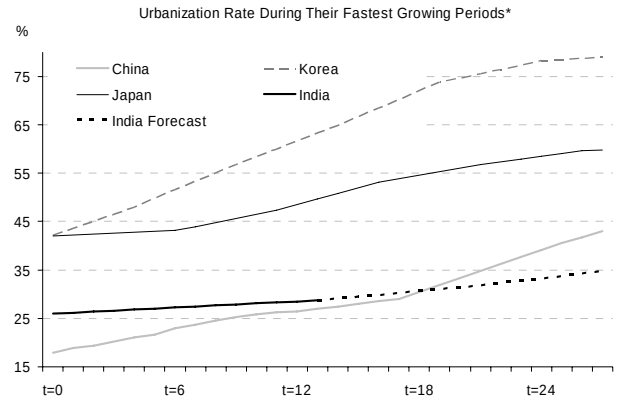
The 21st century is set to become India's 'urban century' with more people living in cities and towns than in the countryside for the first time in its history. India has 10 of the 30 fastest-growing cities in the world and is witnessing rapid urbanization. The growth is happening not in large cities, but in small and mid-sized towns. In 1991, India had 23 cities with a million or more people. A decade later, it had 35.

According to our projections, another 140 million rural dwellers will move to urban areas by 2020, while a massive 700 million people will urbanize by 2050. This is because India's urbanization rate of 29% is still very low compared with 81% for South Korea, 67% for Malaysia, and 43% for China. Rural-urban migration in India has the potential to accelerate to higher levels as, judging by the experiences of other countries, migration tends to hasten after a critical level of 25-30% urbanization is reached, and due to faster economic growth.

Urbanization is spurred by both push and pull factors. Deteriorating agricultural productivity, caste barriers, and unemployment in villages push rural inhabitants out, as better opportunities in cities, very high growth in the construction industry, and demonstration effects from other migrants pull rural workers into urban centers.

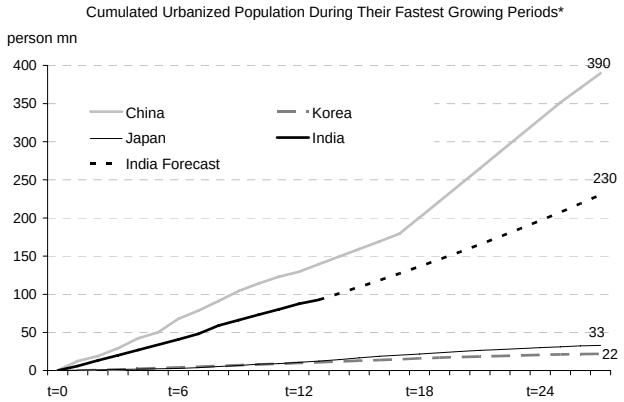
The implications for productivity growth are significant. Our estimates show that movement of labor across sectors, primarily from agriculture to manufacturing and services, adds 0.9 pp to GDP growth a year, a process that is likely to continue, if not accelerate, as urbanization continues. Demand for urban housing and infrastructure such as electricity, health care, sanitation, and education is set to jump several-fold. Policy will, however, need to address basic infrastructure shortfalls in order to take advantage of the 'urbanization bonus.'

Exhibit 12A: India's urbanization–still in the initial stages



* India: 1992- 2019, China: 1978-2005, Korea: 1971-1998, Japan: 1955-1982.

Exhibit 12B: The impending boom in city life



* India: 1992- 2019, China: 1978-2005, Korea: 1971-1998, Japan: 1955-1982.

Source: World Development Indicators, Goldman Sachs Economic Research

Reason #6: The land factor

The imminent shift in land from agriculture to urban use and industry constitutes another source of potential productivity gain. Land is a critical input that is needed to keep the development process moving, allowing for the shift of people from the rural to the urban sector. Access to land is needed for factories, housing projects, and to create tens of millions of jobs in construction in the short run, as well as longer-run jobs.

When land moves from low productivity agriculture to urban use and higher productivity sectors, overall productivity improves.[17] However, India would need investments in agriculture to boost productivity, especially in rural connectivity, storage, etc. to improve the yield of remaining agricultural land.

The creation of the new Special Economic Zones (SEZs)[18] holds the potential of transforming the productivity of agricultural land. Ideally, India should develop economy-wide infrastructure and the necessary investment climate to enable the move from agriculture to industry and services. In the absence of governmental resources (or the ability) to do so, the SEZs will attract private-sector as well as foreign investment, thus helping to develop much-needed infrastructure, generate employment and facilitate urbanization.

Productivity gains for the economy tend to be a cumulative process. Higher productivity leads to more confidence and increased openness, which means more technology and investment, and sustained productivity growth. The building of highways will not only lower costs for companies but also enable rural-urban migration, development of cities, and the process of moving land from agriculture to industry and services. These in turn attract more investment through agglomeration effects, and thus sustain growth.

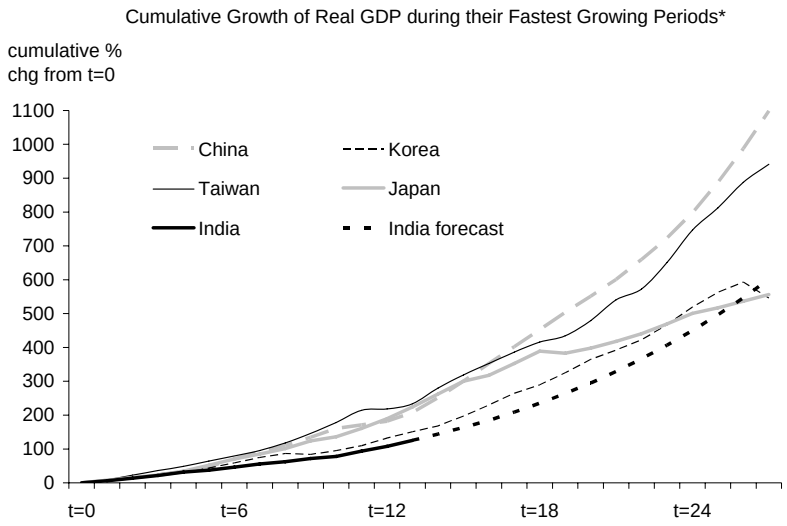
V. How plausible is our growth scenario?

To check the plausibility of our projections, we compared India's growth projections with actual outcomes for its East Asian neighbors. Such high-growth phases during transition from low-income to middle-income are fairly common. For instance, Japan increased its output eightfold between 1955 and 1985, while Korea increased its GDP by nearly 9 times between 1970 and 2000. More recently, China (starting from the same level as India in 1978) has achieved a more than tenfold increase in its output in the 27 years to 2005. By contrast, India's growth transition, based on our projections of 8.4% growth from 2007 to 2020, do not appear implausible.

[17] Evidence from China shows that as land was moved between sectors, marginal productivity went up. Additionally, "food security" was not threatened, as agricultural output went up, in part due to additional land being cultivated and added to the stock, as well as increases in yields of existing land. See Deng et. al. (2006).

[18] The SEZs offer generous tax incentives and envisage heavy private-sector involvement in zone development and management. The corollary is that the government's taxable base will be eroded.

Exhibit 13: Growth transitions: India still has a lot of catching up to do



* India: 1992- 2019, China: 1978-2005, Korea: 1971-1998, Japan: 1955-1982.
Source: CEIC, Goldman Sachs Economic Research.

The investment rates that we envisage for India in our baseline scenario are well below the range achieved by other countries in East Asia. For instance, Korea sustained an average investment of over 35% for more than 30 years, while China has seen investment rates of roughly 43%. India's capital per worker is one of the lowest in the world, and there is considerable room to catch up.

Exhibit 14: Plenty of room ahead for capital deepening in India

(Capital stock in 2004, current price)

	Capital Stock / GDP	Capital Stock per capita (USD)
US	2.9	152,367
Japan	4.4	158,352
China	2.5	3,751
India	2.2	1,282

Source: Vikram and Dhareshwar (1993), CEIC, Central Statistical Organization of India, Goldman Sachs Economic Research.

Even in terms of educational attainment, India is not starting off on its growth transition at a considerable disadvantage to its East Asian neighbors. For instance, in terms of average years of schooling, the figure in India was 4.3 in 1992, compared with 4.6 for China in 1978, 4.7 for Singapore in 1967 and 5.3 for Korea in 1971.

Our assumptions on productivity growth rates seem reasonable when compared to other high-growth episodes. China has sustained TFP growth rates of 3.5% on average for 27 years over its high-growth phase.[19] The low initial starting point for India implies greater scope for catch-up with other emerging and developed economies.

Another way to cross-check our projections is to ask whether the economy is close to its optimal level of productivity, also known as its production possibilities frontier, given its stage of development, its political, legal, and economic institutions, and its geography. A previous study found that India's TFP level is between one-third and 40% of what it should be, creating the scope for productivity improvements based on just catching up.[20]

The Growth Environment Score (GES) for India provides a different method of estimating the gains that India can attain if it were to reform in areas outlined in Box 2 on the next page. Based on the GES, the contribution to annual GDP growth could be as much as 2.8 pp. These independent analyses suggest the enormous scope for catch-up.

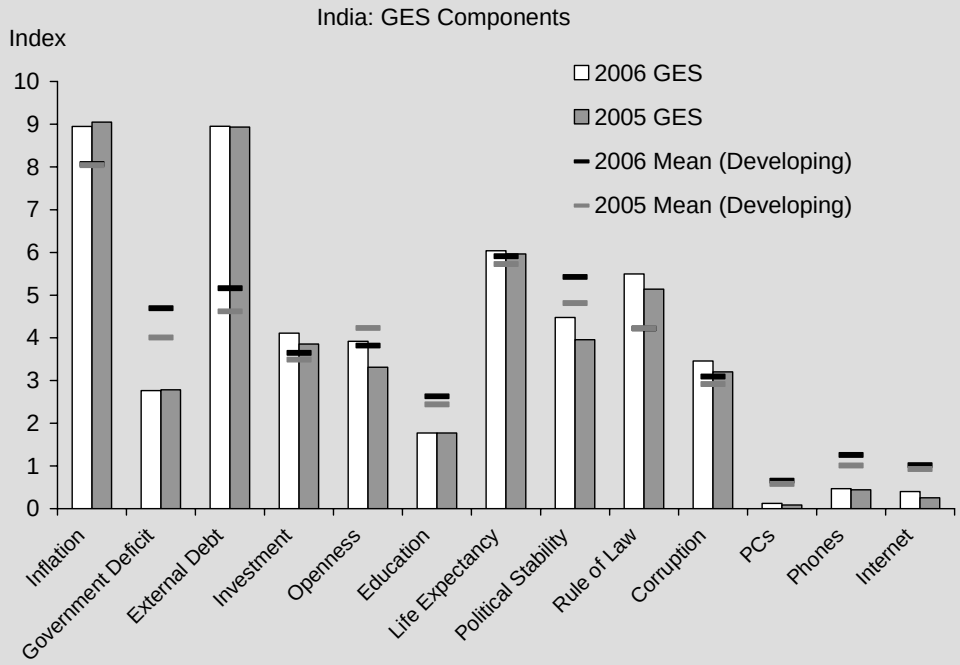
[19] See Hong Liang and Eva Yi, *China's Ascent: Can the Middle Kingdom Meet its Dreams*, Global Economic Paper No 133, November 11, 2005.

[20] Rodrik, Subramanian and Trebbi (2004), op. cit.

Box 2: India's growth environment

The Goldman Sachs Growth Environment Score (GES) allows us to compare India with its peers at comparable income levels, and provides a perspective on where the greatest scope for improvement lies.[21] India's macro environment and political conditions are generally conducive for growth. The key drawbacks are the high fiscal deficit, low penetration of PCs, phones, and Internet, and especially low education levels. India can improve its growth potential by an annual 2.8 pp by moving to the best in its class of low-income countries.

Exhibit B5: GES components



Source: Goldman Sachs Economic Research.

How India rates in each of the GES components

Macroeconomic stability

1. *Inflation*: Historically, inflation has been relatively well-contained in India due to a strong commitment by the central bank and the Ministry of Finance. Even though in recent months commodity and food prices have risen, inflationary expectations have been well managed given the credibility of the central bank.

2. *Government deficit*: The consolidated fiscal deficits of the center and states are high in India both in absolute terms and relative to its developing country peers. However, with the current growth momentum and consequent buoyancy in revenues, we expect an improvement in macro-fiscal stability, given the implementation of the Value-Added Tax (VAT), and the government's commitment to the Fiscal Responsibility Act (FRBMA), which envisages a reduction in the fiscal deficit by 0.3% a year. Although it needs to fall further, the general government deficit has come down from 10.1% in FY2001 to an estimated 6.3% of GDP in FY2006, with both central and state finances showing a marked improvement. However, to boost investment substantially, a further improvement in the consolidated deficit will be necessary.

3. *External debt*: At 17% of GDP, India's external debt is low. Thus, external and currency risks are manageable.

[21] The GES is a summary measure of a broad set of conditions that help to achieve growth potential. For details, please see *You Reap What You Sow: Our 2006 Growth Environment Scores (GES)*, Global Economics Paper No: 148, November 8, 2006.

Box 2 continued

Macroeconomic conditions

4. *Investment*: Although India's investment/GDP ratio is not high by regional standards, gross capital formation has risen in recent years and the outlook for investment growth is strong, especially in areas such as infrastructure and retail. However, bureaucratic red tape continues to be a bugbear for the investment climate.

5. *Openness*: Tariffs have gradually been reduced and India is negotiating a clutch of free-trade agreements. We expect openness and trade to improve, with positive consequences for productivity growth.

Human capital

6. *Education*: India compares very unfavorably with its peers in indicators of educational attainment at all levels. In 2000, the working-age population's average year of schooling is about 5.1 in India, compared with 6.4 in China and 6.8 in Malaysia.[22] Both the spending and the efficiency of spending on education remain weak. The shortfall in education is a key constraint to growth.

7. *Life expectancy*: Comparable to developing countries and on the rise due to increases in income, health care, and nutrition. Fiscal spending on health care, however, remains inadequate and large sections of the population have no access to health care.

Political conditions

8. *Political stability*: Democracy and democratic values are relatively well-entrenched and the political system is largely stable. Handover of power after general elections held every 5 years is peaceful, and confidence in the stability of the system is high. However, there are incipient threats to stability from the extreme left-wing Naxalite movement, which needs to be monitored closely.

9. *Rule of law*: India ranks above its peers in rule of law due to a relatively well-functioning judiciary. However, cases drag on for years, and further improvements in the legal process are necessary to improve the business climate.

10. *Corruption*: Although its score is higher than the developing country mean, bureaucratic and administrative corruption, and rent-seeking by a large public sector continue to restrain investor confidence.

Technological capabilities

11-13. *PCs/Phones/Internet*: India is starting from a very low base in technological capabilities, and ranks well below the developing country average. However, connectivity and PC penetration is expanding rapidly. It is the fastest-growing market for mobile phones, now adding some 20 million subscriptions a year.

[22] Barro, Robert J. and Jong-Wha Lee, *International Data on Educational Attainment: Updates and Implications*, CID Working Paper No. 42, April 2000.

VI. Where do we see the constraints to growth?

Obviously, such a growth scenario is not without risks. Here we assess these risks and consider whether they can derail the growth process. As Box 2 on India's growth environment outlines, India will need continued progress in reducing the fiscal deficit, and in enhancing education at all levels. We also see threats to the growth process from protectionism, supply-side constraints to doing business, and environmental degradation.

A rapidly-growing economy is often accompanied by an initial increase in income inequality (the famous Kuznets curve), which in India's case can manifest itself in a growing rural-versus-urban and an educated-versus-uneducated divide. With rising aspirations, it is critical for the economy to have 'inclusive' growth, with employment opportunities for all. Education and labor market reform will be important in this respect. Otherwise, rapid growth could lead to rising social tensions, political pressure to slow down the reform process and increasing protectionism from reservations in education and jobs. If managed badly, this has the potential to kill the growth goose.

The old risk of sectarian disharmony is now supplemented with the new risk of political discontent spawned by dissatisfaction with the unequal distribution of economic growth. How effectively the political process manages these risks will be central to India's economic performance. Fortunately, thus far, there is a wide consensus among political parties in India to enhance the reform process. However, there are considerable risks that India will not be able to achieve 'inclusive growth' without sacrificing average growth rates. The most direct manifestation of this risk is costs to the public sector of 'populist' policies, which reduce public savings and the ability to finance the required investment growth.

India will need to alleviate supply-side constraints in order to absorb the labor coming out of agriculture and to sustain the growth momentum we have outlined. It takes an entrepreneur 35 days to start a business, 270 days to obtain various licenses and permits, 62 days to register a property, nearly 4 years to enforce contracts, and a shocking 10 years to close a business.[23] It is also extremely difficult to lay off workers in India, and on average it costs more than a year's wage.

Even though India is making progress in reducing red tape, the scale of the problem remains immense. Action on these issues is important because it is the small and medium-sized enterprises that create the most jobs.

To embark upon its growth story, India will have to educate its children and its young people (especially its women) and it must do so in a hurry. Lack of education can be a critical constraint to the growth of the knowledge-based IT sector, as well as in the move to mass employment in manufacturing. The demographic dividend may not materialize if India fails to educate its people.

The success of India's elite students from the IITs and IIMs masks the generally abysmal state of higher education in India. Higher education remains heavily regulated, with little to encourage private-sector participation or innovation. There are, however, changes taking place. Labor market returns to education have risen in recent years, leading to an increase in demand for better quality, and as a result the private sector is beginning to step in to fill the supply gap.

[23] See *Doing Business*, IFC 2006.

We believe that a critical risk to the long-term growth potential of India is environmental degradation. The country remains largely rural, and normal monsoons are the life-blood of the system. With increased urbanization, industrial development, and a burgeoning need for energy, India will be a large contributor to global warming. Climate change can cause erratic monsoons, with grave implications for rural incomes and overall growth. Already, shortages in water are occurring with concerning rapidity. If water and electricity are not priced at close to long-run marginal social cost, the shortages will become critical. In order not to hamper the growth process, India will need to put in place policies that are increasingly environmentally-friendly.

Although these risks are important, there would need to be dramatic deterioration in them to fundamentally derail the growth process. Comfort can be derived from the fact that India's growth experience in the past 2 decades has been achieved with low volatility. More recently, strong economic performance has been achieved during a period of rising oil prices and with the economy remaining relatively closed. A high level of reserves, a falling fiscal deficit, low external debt, and a low current account deficit give further reassurance about the underlying strength of the current growth momentum.

Our projections of India's potential growth are based on growth-friendly policies continuing to be implemented. We would emphasize the 'FORCE' factors policies as critical to sustaining growth, in particular, policies to enhance Financial sector growth, Openness to trade, Rural-urban migration, Capital formation, Education, and Environment.

VII. Conclusion: India can become a motor for the global economy

Any kind of long-term projection is subject to a great deal of uncertainty, and we need to be mindful that India's growth transition is unlikely to be smooth or devoid of shocks. The development experiences of countries are littered with examples of failure due to bad policies or simply bad luck. However, our projections provide a framework based on clear assumptions, with the help of which investors can assess future developments, as well as position themselves to take advantage of emerging opportunities.

In absolute terms India will remain a low-income country for several decades, with per capita incomes well below its other BRIC peers. But if it can fulfill its growth potential, it can become a motor for the world economy, and a key contributor to generating spending growth.

India's imminent urbanization process has implications for demand for housing, urban infrastructure, location of retail, and demand for consumer durables. We expect the coming on-stream of major highways (especially the Golden Quadrilateral) to drive growth in the transportation sector, spur demand for vehicles, increase real estate values along the corridor, and potentially boost construction of suburban homes as people escape congested cities. The SEZs hold out substantial investment opportunities in all spheres of activity.

There are implications for India's neighbors in South Asia, who also stand to benefit from spillovers, just as China's growth aided its East and South East Asian neighbors.

Our projections are for India's potential output, i.e., growth rates that are possible under particular conditions—rather than a central case of what will happen. There can, of course, be a big gulf between potential and reality. Given the considerable implications, India's ability to turn potential into reality should be of pressing importance not only for the fate of its 1.1 billion citizens, but also for the progress of the global economy.

Appendix I: Estimating and forecasting India's potential growth

I. Neoclassical model of growth accounting

In accounting for the sources of growth, economists commonly use a Cobb-Douglas production function to estimate the contribution to growth from physical and human capital accumulation, as well as productivity gains. The measure of productivity used is total factor productivity (TFP), measured as the "residual part" of economic growth that is not accounted for by the accumulation of physical or human capital.

$$Y = AK^{\alpha}(L \times E)^{(1-\alpha)} \qquad (1)$$

where
Y: Total (real) output
A: Total factor productivity (TFP)
K: (Real) physical capital stock
α: Factor share of capital
(1- α): Factor share of labor
L: Labor inputs
E: Labor quality index based on average educational attainment

By taking the difference in natural logarithms of Equation (1), we can derive the various input contributions to output growth (where a dot above a variable denotes its time derivative):

$$\dot{Y} = \dot{A} + \alpha\dot{K} + (1-\alpha)\dot{L} + (1-\alpha)\dot{E} \qquad (2)$$

and

$$\dot{A} = \dot{Y} - \alpha\dot{K} - (1-\alpha)\dot{L} - (1-\alpha)\dot{E} \qquad (3)$$

As we can see from Equation (2), GDP growth ($\dot{Y}$) can be boosted by higher growth in labor inputs ($\dot{L}$), educational attainment ($\dot{E}$), capital stock ($\dot{K}$), as well as TFP ($\dot{A}$).

II. Estimating 'potential' GDP growth

'Potential' output is a measure of an economy's productive capacity, or the level of GDP attainable when the economy is operating at a high rate of resource use. It is not a technical ceiling on output that cannot be exceeded. Rather, it is a measure of sustainable output, in which the intensity of resource use is neither adding to nor subtracting from inflationary pressure.

Potential output is commonly estimated through the production function described above. To do so, we must remove cyclical changes in the inputs.

a) De-trending the inputs

We used the Hodrick-Prescott (HP) filter to de-trend the growth rates of capital stock, educational attainment and TFP, and we calculated the trend labor input (L*) using the following equation:

$$L^{*} = P_{wa} \times Part^{*} \times (1 - NAIRU) \qquad (4)$$

Where
P_{wa}: Working age population
*Part**: Trend labor participation rate
NAIRU: Non-accelerating inflation rate of unemployment

We obtained the working age population and employment statistics from the annual population and employment survey conducted by the *National Sample Survey Organization (NSSO)* (please refer to Appendix III for more details on the data sources). Historical labor participation rates are calculated as the percentage share of employment in the working age population, and de-trended using the HP filter. We used the average unemployment rates during 1973-2004 to estimate NAIRU, which came in at 4.4%. The unemployment rates used in the calculation are obtained from the NSSO quinquennial employment surveys.

a) Our estimation results

We inserted the de-trended growth rates of inputs ($\dot{A}$, $\dot{K}$, $\dot{L}$ and $\dot{E}$) into equation (2) to calculate the potential output growth. Exhibit A1 reports our findings, suggesting that the take-off in output and productivity since 2002 is structural rather than cyclical. For the last year in the sample, i.e. 2005-06, potential growth increases to 8.1.

Exhibit A1: Our estimates of potential growth of inputs and outputs

	GDP	TFP	K	L	E
1971-79*	2.9	-2.1	3.8	2.0	3.6
1980-89	5.1	0.7	4.3	1.8	2.5
1990-99	6.0	1.6	5.1	1.8	2.2
2003-05	7.5	3.3	4.6	1.6	2.2

*Note: all years refers to India's fiscal years, which starts from April 1 and ends at March 31.
Source: Goldman Sachs Economic Research.

III. Forecasting potential growth

We made our medium-term GDP growth projections based on the estimated future growth rates of the inputs: i.e., capital stock, labor inputs, educational attainments and TFP (Exhibit A2 on page 28).

a. Labor input

We forecast the trend employment using Equation (4) on page 26, where we took 1) the United Nations' projection of India's working age population, 2) A NAIRU of 4.4% as explained above, and 3) constant trend labor force participation rate.

It could be argued that the trend labor force participation rate should rise, on the back of the ongoing trend increase in the female labor force participation rate. In keeping with our conservative assumptions for the baseline, we kept participation rates unchanged. If it were to increase in the future, then potential GDP growth could come in higher than our current projections.

b. Capital stock

The projections for the baseline assume that investment/GDP ratio is fairly constant. With GDP growth at the 8% level, capital stock growth will have to accelerate in order to keep the incremental investment/GDP ratio constant. Therefore, we have built in a pickup in capital stock growth in our forecast.

c. Productivity growth

For the reasons discussed in the text, we believe India's ongoing productivity surge can be sustained over the medium term. We project an average growth rate of 3.3% in 2006-2020, which is similar to the average trend TFP growth that was achieved in 2003-2005. From 2020 onwards, we have assumed a gradual moderation in TFP growth down to 2.0% in 2050, with an average growth of 2.3% in 2021-2050.

d. Educational attainment

We have assumed a gradual slowdown in growth of the average year of schooling over time, so that by 2050 the average year of schooling for the work age population reaches about 11 years.

IV. Estimation results

Using the Cobb-Douglas production function, with our assumption of factor shares of capital and labor (see Appendix III for more details on data and our assumptions), we found that overall productivity growth surged from an average of 1.3% in the 1990s to 3.5% in the past 3 years, contributing to just under half of the total GDP growth. Exhibit A2 shows that the percentage point contribution of human and physical capital accumulation to GDP growth remains roughly the same compared with the 1990s, and the surge in productivity gains is the primary driver behind the high GDP growth in 2003-2005.

Exhibit A2: Sources of economic growth: History and projections

	Average Growth (% chg yoy)					Average percentage point contribution to growth				Average share of contribution to growth (%)			
	GDP	TFP	K	L	E	TFP	K	L	E	TFP	K	L	E
1971-79*	2.7	-2.2	3.7	2.0	3.7	-2.5	1.2	1.4	2.6	-90.6	45.0	50.8	94.8
1980-89	5.8	1.4	4.4	1.9	2.4	1.4	1.4	1.3	1.7	24.5	24.7	22.3	28.6
1990-99	5.8	1.3	5.4	1.7	2.2	1.3	1.8	1.2	1.5	22.9	30.5	20.7	25.8
2003-05	8.1	3.5	5.6	1.8	2.2	3.5	1.8	1.2	1.5	43.5	22.7	15.0	18.8
2006-10E**	8.2	3.0	7.2	2.0	2.0	3.1	2.4	1.4	1.4	37.7	28.6	16.5	17.2
2011-20E	8.5	3.3	8.3	1.6	1.9	3.4	2.7	1.1	1.3	40.1	31.8	12.7	15.4
2021-50E	6.2	2.2	7.9	0.6	1.4	2.3	2.6	0.4	0.9	36.8	41.2	6.7	15.2

* All years refers to India's fiscal years, which starts from April 1 and ends at March 31.

** Our projection

Source: Goldman Sachs Economic Research.

Appendix II: The sectoral production functions

I. Disaggregating the production function

We estimated 3 separate production functions for the sectors of agriculture, industry, and services. This approach is useful as different sectors have different methods of production and different capital intensities, which would be lost by using an economy-wide production function. This is especially true in India, where agriculture still constitutes a sizable share of output, and a disproportionately large share of labor.

Second, such an approach allows us to model shifts in the importance of different sectors, and, in particular, the movement of labor away from agriculture to manufacturing and services – a key process underway in the Indian economy.

The Cobb-Douglas production function [Equation (1)] can be applied at the sectoral level as:

$$\begin{aligned} Y &= AK^{\alpha}(L \times E)^{(1-\alpha)} = Y^A + Y^I + Y^S \\ &= A^A(K^A)^{\alpha^A}(L^A \times E^A)^{(1-\alpha^A)} + A^I(K^I)^{\alpha^I}(L^I \times E^I)^{(1-\alpha^I)} + A^S(K^S)^{\alpha^S}(L^S \times E^S)^{(1-\alpha^S)} \end{aligned} \quad (5)$$

where
superscripts *A* stands for agriculture, *I* for industry, *S* for services.

Y: Real output
A: Total factor productivity (TFP)
K: Real physical capital stock
α: Factor share of capital
(1- α): Factor share of labor
L: Labor inputs
E: Labor quality index based on average educational attainment

The results are present in Exhibit 5 on page 8. At the sectoral level, we find a turnaround in productivity growth in the manufacturing sector has boosted overall TFP growth. However, we also find that the sum of productivity growth in all of the 3 sectors came in considerably lower than the aggregate productivity growth. The difference between the weighted sectoral sum of TFP growth and the aggregate TFP growth represents the productivity gains from a shift of land, capital and labor into more productive sectors, holding constant the overall physical and human capital inputs.

II. Estimating the contribution of migration of labor to GDP growth

We used a simple framework to estimate the impact of labor mobility on growth rates. We broke down GDP growth into three components: 1) the contribution from sectoral increases in labor productivity, suitably weighted by the sector's share in GDP; 2) the contribution from growth in the labor force in the sector, in the absence of labor mobility, again weighted by the sector's share in GDP; 3) the impact on GDP growth from inter-sectoral labor mobility, in the presence of differences in sectoral labor productivity levels.

These are summarized in the equation below:

$$\begin{aligned} g &= S^A\pi^A + s^I\pi^I + (1 - S^A - S^I)\pi^S \\ &+ S^A n^A + s^I n^I + (1 - S^A - S^I)n^S \\ &+ (l^A \times \frac{\prod^I - \prod^A}{\prod} \times m^{AI}) + (l^A \times \frac{\prod^S - \prod^A}{\prod} \times m^{AS}) + (l^I \times \frac{\prod^S - \prod^I}{\prod} \times m^{IS}) \end{aligned} \quad (1)$$

where:

superscripts *A* stands for agriculture, *I* stands for industry, *S* stands for services.

g: GDP growth
s: share of a sector in GDP
n: natural rate of growth of labor force in the sector
l: share of a sector in total employment
Π: level of labor productivity
π: growth rate of labor productivity
m: the net movement of labor between sectors (e.g., m^{AS} stands for labor movement from agricultural to industry).

The contribution of inter-sectoral labor mobility on overall GDP growth is represented by:

$$(l^A \times \frac{\prod^I - \prod^A}{\prod} \times m^{AI}) + (l^A \times \frac{\prod^S - \prod^A}{\prod} \times m^{AS}) + (l^I \times \frac{\prod^S - \prod^I}{\prod} \times m^{IS}) \qquad (2)$$

Using equation (2), we estimate that inter-sectoral labor reallocation alone has contributed at least 0.7 pp to GDP growth in 1981-1990, 0.5 pp in 1990-1997 and 0.9 pp in 1997-2004.

III. Notes on data and assumptions

1. Physical capital stock data and depreciation rate

Physical capital stock data for fiscal year (FY) 1999-2004[24] are taken from *National Account Statistics* (2006) compiled by the India Central Statistical Organization (CSO), where its breakdown by industry is also provided. The base for this latest capital stock series is FY 1999, and for years prior to FY 1999 we used the growth rate of real capital stock based FY1993 to get the capital stock statistics. For TFP calculation in FY 2005, we assumed the same growth rate of capital stock in FY2005 as in FY2004, which was 5.6% year on year (yoy).

We assumed the annual depreciation rate of 6.5% for 2006-2020 in calculating the implied investment/GDP ratio under our forecast. 6.5% is the average implied depreciation rate in the past 3 years. For 2020 onwards, we assumed a lower depreciation rate of 6%, due to a moderation in GDP growth.

2. Factor share of capital (α)

Empirical estimates from a number of countries and studies suggest that α is between 0.3-0.4. For our sectoral estimates, given that factor income of capital tends to be higher in industry than in services/agriculture, we set α=0.4 for industry and α=0.3 for agriculture as well as services. We calculated the overall α=0.33 using the weighted average of α in agriculture, industry and services, with the weight derived from their share in total outputs.

3. Data on labor input and educational attainment

a. Labor input (*L*)

Overall labor force and employment statistics are taken from the annual population and employment survey conducted by the *National Sample Survey Organization (NSSO)*.

NSSO also conducts quinquennial surveys on employment and unemployment, which provides us with the employment and unemployment ratios by industry among rural male, rural female, urban male and urban female population. The latest NSSO quinquennial survey was conducted in FY2004/2005, and published in September 2006.

[24] Fiscal year 1999 runs from April 1, 1999–March 31, 2000.

We estimated the industrial level employment by combining the NSSO annual and quinquennial surveys:

1) We estimate the annual rural male, rural female, urban male and urban female population using the NSSO total population and female as % of total population data, as well as the urbanization ratio from the World Bank's *World Development Indicators*.

2) We then calculated the employment among those population groups using their correspondent employment ratios from NSSO quinquennial surveys.

3) We added together the employment among the population groups for overall employment by industry. We assumed the same growth rate of employment between two quinquennial survey years to extrapolate the annual series of employment by industry. Although this approach has its limitations of over-smoothing between the survey years, it avoids making groundless assumptions of variations in employment growth. Further, since we are only focusing on the employment and productivity change over a longer time period (5-10 years), the qualitative impact of this assumption on our results should be minimal.

a. Unemployment rates

We combined the NSSO annual and quinquennial surveys to estimate the overall unemployment rates. More specifically, we estimated the overall unemployment rate using unemployment ratios by population groups (of rural male, rural female, urban male and urban female) and the estimated population within these groups (As in the employment calculations described above).

b. Educational attainment (*E*)

Changes in educational attainment are used to measure the improvement in labor quality in India. We compiled a labor quality index using the average years of schooling of the population aged 15 years and above.

Barro and Lee (2001) compiled a time series of working population's average years of schooling for India, which covers years 1960-2000. For years after 2000, we used the average growth rate of educational attainment during 1995-2000 to extend the series to 2005.

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