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UNDERLYING DRIVERS OF INDIA'S POTENTIAL GROWTH

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Abstract

Estimating future potential growth under alternative policy trajectories can be useful in making current policy choices affecting future growth. Given the tepid global growth prospects in the medium term, India will have to depend largely on its domestic growth drivers. In this paper, a methodological framework for estimating India's future potential growth has been proposed. This approach focuses on the determination of the growth path of capacity output. The period considered is up to 2029-30. In particular, we highlight the relative roles of (a) growth of investible resources comprising domestic savings and net capital inflows, (b) differential prices of investment goods vis-à-vis consumption goods and services, (c) sectoral incremental capital-output ratios, (d) the changing weights of sectoral outputs in total output due to sectoral growth rate differentials, and (e) the buoyancy of net product taxes. We derive growth paths of India's potential growth under alternative assumptions with a view to considering policy options in the present for driving the economy towards a suitable future growth path. The most potent growth-augmenting driver remains an uplifting of the domestic saving rate.

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INTRODUCTION

Estimating potential future growth under alternative policy trajectories can be useful in making contemporary policy choices affecting future growth. Given the tepid global growth prospects in the medium term, India will have to depend largely on its domestic growth drivers. In this paper, we have developed a methodology for examining India's future growth potential. Although a number of methods for estimating potential growth and their applications for India are available in the literature, most of these, with a few exceptions, look at the past rather than the future. In section 2, we briefly review selected studies estimating India's potential growth rates. In section 3, we develop a methodology for estimating India's future potential growth and for highlighting the relative role played by its key drivers. Section 4 brings together key data relating to saving, investment, and sectoral growth using the new 2011-12 base GDP series. Section 5 highlights the basic characteristics of the base run estimating India's potential growth up to 2029-30. Section 6 presents the results of simulations under alternative assumptions and provides a cross-simulation comparison. Section 7 provides concluding observations.

Estimating Potential Growth in India: Overview of Selected Studies and Methodologies

Potential output in any given period refers to output achievable by the full utilization of production capacity. Actual output may differ from potential output. When actual output exceeds potential output, inflation increases as it implies that aggregate demand is higher than aggregate supply consistent with full capacity utilization. Potential growth is growth in capacity output. In a dynamic setting, potential output increases as capacity expands.

A commonly used method of estimating potential growth is to estimate trend output using the history of actual outputs. Usually the trend path of actual output is captured by using statistical filters such as the H-P or band-pass filters. An alternative approach is to determine trend output by using a structural method such as the production function approach. Sometimes a statistical filter is combined with structural analysis. In most analyses, the focus is on determining the output-gap, i.e. the difference between the actual output and potential output of an economy. In the group of structural methods, one popular method is to estimate, using a production function such as the Cobb-Douglas production function, the contribution of labor and capital and total factor productivity (TFP) growth, where the latter is derived as a residual.

In the Indian context, both methods have been used extensively. For example, Donde and Saggar (1999), Ranjan *et. al.* (2007), Bordoloi *et. al.* (2009), and Mishra (2013) use statistical filters to estimate the potential output. Bordoloi *et. al.* (2009), Goyal and Arora (2012), and Mishra (2013) have used structural VAR methods or other statistical filters for estimating potential growth. Ranjan *et. al.* (2007) have used a production function approach for deriving the contribution of total factor productivity.

While most of these studies have estimated potential output/growth for selected historical periods, some have used specific assumptions regarding TFP growth and other determinants for specified future periods to make projections. Thus, using TFP growth at 2.5 per cent and capital share of 0.35, Rodrik and Subramanian (2004) projected a potential growth of over 7.0 per cent for India up to 2025. Poddar and Yi (2007), taking TFP growth at 3.3 per cent, found that India's potential growth could be about 8 per cent until 2020. A recent review of these studies relating to India's potential growth is provided in Bhoi and Behera (2016).

The Economic Survey of 2015-16, brought out by the Ministry of Finance, provides a technical discussion on estimating future potential growth by comparing China and India. It estimates India's potential growth to be in the range of 8 to 10 percent up to 2029-30 using a determinants-cum-convergence approach based on the empirical finding that institutions are a key determinant of long term growth [North (1991)]. A strong relationship between institutional development and economic development has been empirically observed but both India and China are outliers to this observed pattern. While China has grown at an abnormally high rate, India has grown at a rate much slower than that warranted by its political and institutional development. Both countries are expected to 'mean-revert' or converge to the observed average pattern. China is expected to normalise through a combination of slower growth and faster democratization while growth in India is expected to accelerate at a much faster pace. Setting the US as a benchmark, all countries are expected to converge to its per capita PPP GDP level at an average pace of 2 percent. India's convergence coefficient is expected to be relatively higher since it has under-achieved its potential so far. On this basis, India's medium-term growth potential is estimated between 8-10 percent while at the same pace of convergence, China's growth potential is estimated to be between 4-6 percent.

Burns (2016) provides estimates of potential output growth for a sample of 26 Asian economies including India for the period 2015-2040. Burns uses the production

frontier approach but unlike many other estimates of total factor productivity, in his study, the TFP estimates are net of the effects of structural change. Burns estimates a baseline scenario and then using Korea as a benchmark, he examines the extent of improvement in potential growth compared to a baseline scenario. In the baseline scenario, India's potential output growth, which was 6.7 percent during 2010-15, falls to 4.1 percent in 2035-40 (Table 2 of Burns, 2016). This outcome can be improved by policy support along four dimensions:

(a) Employment convergence where labor participation rate is increased to reach Korea's labor participation rate in 2014;
(b) Capital convergence where the capital output ratios are increased to converge to Korea's current level,
(c) TFP convergence, net of restructuring, where TFP is increased to reach the current levels achieved in Korea, and
(d) Convergence of economic structure where firms and labor move from lower to higher productivity sectors. In this case, the economies are expected to follow the same pattern of evolution as that of the Republic of Korea.

Once the concerned level reaches Korea's level, it is held constant. The combined impact of policy support in all the four dimensions, increases India's potential output by a little more than 50 percent compared to the baseline projection in 2035-40. Significant gains are obtained by increasing the labor participation rate and TFP. In this study, structural change is reflected in the movement of labor from lower to higher productivity sectors. In our paper, as we explain later, the role of saving and investment in affecting potential growth is emphasized as part of structural change.

Studies based on past data, using the H-P or other filters remain focused on analyzing the past. Studies that have used the structural approach and made projections for the future are highly aggregative and their results depend on assumptions regarding the contribution of total factor productivity. Their estimates of total factor productivity differ widely. In these studies, due to the high level of aggregation, it is difficult to identify the relative role of different drivers of growth so as to draw useful policy lessons for the present. The use of the convergence approach, as given in the Economic Survey of 2015-16, does not provide much guidance as to the process by which growth will be affected. Our focus is on determining growth of capacity output by using a disaggregated approach so that the relative role of different factors affecting future growth of capacity output can be highlighted [for a similar approach, but in a limited

form, see Rangrajan (2016)]. In particular, we highlight the relative roles of (a) differential prices of investment goods vis-à-vis all goods, (b) growth of investible resources, (c) sectoral allocation of investible resources, (d) sectoral incremental capital-output ratios, (e) the changing weights of sectoral outputs in a dynamic setting, and (f) buoyancy of net product taxes with respect to GVA. We derive growth paths of India's potential growth under alternative assumptions with a view to considering policy options in the present for driving the economy towards a suitable future growth path.

Proposed Methodology

Starting with the equilibrium condition that investible resources consisting of domestic savings and net inflow of capital would finance aggregate investment, we draw one key insight relevant for the Indian economy from the Harrod-Domar model, namely, that availability of capital is the binding constraint. Since financing of capital crucially depends on savings, we highlight the role of domestic savings in determining potential output in India in the contemporary context. However, instead of taking an aggregative approach, we consider sectoral disaggregation as critical for determining India's potential growth because of crucial differences in sectoral shares in output and capital stock and in their incremental capital-output ratios reflecting productivity.The supply of labour is not a constraint in the context of high growth of working age population given the demographic trends. The availability of adequately skilled human resources can potentially be a constraint, particularly for specific sectors, but its role is not considered separately in this analysis. Aggregate demand can play a role in forcing actual growth to settle below potential by forcing underutilization of capacity. Our focus is on creation of potential capacity and therefore on the supply side.

The symbols representing key variables used in this analysis are given below.

S : Savings at current prices
I : Investment (gross capital formation) at current prices (I= GFCF+NFC)
GFCF : Gross fixed capital formation at current prices
NFC : Investment in areas other than gross fixed capital formation (e.g. - investment in valuables, inventories)
NIC : Net inflow of capital at current prices (=sustainable current account deficit)
CFC : Consumption of fixed capital at current prices
NI : Investment in net fixed capital formation at current prices
GDP : Gross domestic product at constant (2011-12) market prices
Y : Gross domestic product at current market prices
y : Real gross value added at 2011-12 prices

PY : GDP deflator (base 2011-12 = 1)
PI : Investment goods deflator
α : Investment share in a given sector
C : Incremental *output-capital* ratio (in a given sector)
s : Savings rate (as percent of nominal GDP)
nic : Net inflow of capital rate (as percent of nominal GDP)
g_S : Nominal growth rate of savings (percent per annum)
g^*_S : Real growth rate of savings (percent per annum)
g_{NIC} : Nominal growth rate of net inflow of capital (percent per annum)
g^*_{NIC} : Real growth rate of net inflow of capital (percent per annum)
Π_{PI} : Rate of inflation of investment goods deflator (percent per annum)
g_{GVA} : Growth rate of real GVA (percent per annum)
g_{GDP} : Growth rate of real GDP (percent per annum)

Derivation of Investible Resources

The total investible resources as a ratio of income (GDP at current market prices) are given by the following equation:

Investment in gross capital formation

$$I = S + NIC \quad \ldots (1)$$

Investment here refers to gross capital formation. From this, investment contributing to the net fixed capital formation can be derived[i]. In the 2011-12 base national income account series, sector-wise data on capital formation is available only in gross rather than net terms. Also, it adjusts for valuables and errors and omissions but not for inventories. Hence, we use equation 1 except for the adjustment for investment in valuables and errors and omissions. This relation can be expressed as percentage of GDP at current market prices (Y). Thus,

$$I/Y = (S+NIC)/Y \quad \ldots (2)$$

Here, I, S, NIC, and Y are measured at current prices.

We can convert these at constant prices using deflators for gross capital formation (PI) and gross domestic product (*PY*). Thus

$$(\mathrm{I/PI})/(\mathrm{Y/PY}) = [(S + NIC)/PI]/[Y/PI] \text{ Or}$$

$$(\mathrm{I/Y}) * (\mathrm{PY/PI}) = (\mathrm{PY/PI}) * \{(\mathrm{S + NIC})/\mathrm{Y}\} \quad \ldots (3)$$

Thus, the savings and net capital inflows, when translated into investible resources at constant prices, also reflect a differential price effect, if the inflation rates based on investment deflators and GDP deflators are different. Generally, the saving rate (S/Y) and and the rate of net capital inflow (NIC/Y) are taken as parameters. However, since Y, that is, GDP at current market prices is the key endogenous variable to be determined in the system, we have taken the respective growth rates of saving, g_S and net capital inflows, g_{NIC} as the parameters. Thus,

$$S= \{1+g_S\} S_{-1} \quad \ldots (4)$$

and

$$NIC= \{1+g_{NIC}\} NIC_{-1} \quad \ldots (5)$$

Sectoral Allocation of Capital

We consider eight sectors of the economy. These are:

(1) Agriculture, forestry and fishing
(2) Mining and quarrying
(3) Manufacturing
(4) Electricity, gas, water supply and other utility services
(5) Construction
(6) Trade, hotels, transport, storage, and communications
(7) Financial, real estate, and professional services
(8) Public administration, defence, and other services

Let total investment (gross capital formation) be divided among these sectors by a parameter given by α. Thus investment in sector *i* is given by

$$I_i= \alpha_i I \quad \ldots (6)$$

We have $\sum \alpha_i=1$ to ensure that sectoral investments add to the total available resources.

Output-capital Ratios

The third step involves using the sectoral output capital ratios to derive sectoral outputs. Sectoral output-capital ratios should refer to potential output-capital ratios. Year-to-year output-capital ratios show considerable variations. In years when actual output is below potential, there will be underutilization of capacity, and the actual output-capital ratio will be below the potential output to capital ratio. The underlying trend in the series of actual output-capital ratios can be seen as indicating the potential output-capital ratio. The incremental output-capital ratio measured in real terms, that is, the ratio of change in

real output (indicated by y) to change in capital (investment measured at constant prices) for the ith sector is given by

$$\Delta y_i/(I_i/PI) = C_i = \Delta y_i/\alpha_i\,(I/PI)$$

where C_i is the incremental output-capital ratio as given by the available technology, we then have

$$\Delta y_i = C_i * \alpha_i(I/PI) \quad \ldots(7)$$

Growth Rate: Weighted Average of Sectoral Growth Rates

We can write the growth rate for GVA as

$$g_{GVA} = \Delta y/y_{-1} = (\Delta y_1 + \Delta y_2 + \cdots \Delta y_n)/y_{-1}$$

For the ith sector,

$$\Delta y_i/y^i_{-1} = C_i * \alpha_i * (I/PI)/y^i_{-1}$$

Where α_i is the share of investible resources in total investment allocated to the i^{th} sector ($=I_i/I$) and, $(I/PI)/\ y^i_{-1}$ is the aggregate investment at constant prices with respect to the GVA of the i^{th} sector in the previous year, and C_i is the incremental output-capital ratio for the i^{th} sector.

Thus, growth for the i^{th} sector is

$$g^i_{GVA} = \left(1/_{y^i_{-1}}\right) C_i * \alpha_i * [I/PI] \quad \ldots(8)$$

where i varies from 1 to 8 covering sectors listed earlier.

If actual C_i is used, the model will reproduce actual sectoral growth. However, if Ci is replaced by a normative C^*_i, which can be the trend incremental output-capital ratio or average or maximum over a selected period, the corresponding growth projection can reflect potential growth or peak potential growth[ii]. We may allow these to change over the years to reflect productivity changes due to innovations. Thus, a revised version of equation (8) can be used for estimation of potential growth as given below.

$$g^i_{GVA} = \left(1/_{y^i_{-1}}\right) \alpha_i * C^*_i * [I/PI] \quad \ldots(9)$$

Sectoral growth rates are given by ($\Delta y_i/y^i_{-1}$) and the overall growth rate is a weighted sum of the sectoral growth rates and their respective shares in output. Thus,

$$g_{GVA} = \Delta y/y_{-1} = (\Delta y_1/y^1_{-1}) * (y^1_{-1}/y_{-1}) + (\Delta y_2/y^2_{-1}) * (y^2_{-1}/y_{-1}) \ldots + (\Delta y_n/y^n_{-1}) * (y^n_{-1}/y_{-1})$$

In other words, aggregate growth rate is the sum of sectoral growth rates weighted by their respective shares in GVA.

$$g_{GVA}=\Sigma W_i.g^i_{GVA} \quad \ldots(10)$$

Where $W_i= y^i_{-1}/y_{-1}$, that is, the share of output of sector *i*, in the total output.

Thus, the aggregate growth rate depends on (a) sectoral investment shares in total investment, (b) sectoral output shares in total output, (c) sectoral (normative) incremental output to capital ratios, and (d) differential price deflators for investment goods vis-à-vis other goods and services. Sectoral investment shares may be considered as determined by policy. Sectoral output shares are determined endogenously. Differential sectoral growth rates in the current year will change the sectoral shares for the next year. This imparts a dynamic element to the exercise. In translating GVA growth to GDP growth, we can also take into account the effect of buoyancy of product taxes net of product subsidies or net product taxes with respect to GVA as explained below.

From GVA to GDP

Since output is measured in terms of GVA, this analysis gives us results in terms of GVA growth. GVA growth can be translated into GDP growth by adjusting for product taxes net of product subsidies (NPT). If we assume β to the buoyancy of real NID with respect to real GVA, GDP growth can be linked to GVA growth as follows.

$$\beta = (\Delta \mathrm{NPT}/\mathrm{NPT}_{-1}) * (\mathrm{y}_{-1}/\Delta \mathrm{y})$$

Writing the GVA growth rate as $g_{GVA}= \Delta y/y_{-1}$, we can derive

$$\mathrm{NPT}=\mathrm{NPT}_{-1}*\{1+ \beta. g_{GVA}\} \quad \ldots (11)$$

and

$$\mathrm{GDP}= y+\mathrm{NPT}$$

It can further be shown that growth of GDP, say g_{GDP} can be written as

$$\mathrm{g_{GDP}} = \frac{g_{GVA} * [\mathrm{y}_{-1} + \beta \mathrm{NPT}_{-1}]}{\mathrm{GDP}_{-1}} \quad \ldots (12)$$

The system is driven by growth rate of nominal saving and nominal inflow of capital which provide the current levels of saving and investment. These investments are converted into output through a technological relationship captured by the sectoral capital-output ratios. Sectoral allocation of investment as well as price deflators for

output and investment are exogenous. This implies that the weights attached to sectoral growth rates keep changing in favour of sectors with relatively high output-capital ratios.

Equations 1, 3, 7, 8, and 10 and 12 describe the system for determining GDP growth. Bringing together different components, we can write the real growth of GDP as given by:

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C_i^*\right] * \left[\frac{PY_{-1}}{PI_{-1}}\right] * \left[s_{-1}\left[1 + \frac{g_s^*}{(1+\pi_{PI})}\right] + nic_{-1}\left[1 + \frac{g_{nic}^*}{(1+\pi_{PI})}\right]\right] * (y_{-1} + \beta\, NPT_{-1})$$

In this system, the parameters are α_i, C_i, g^*_S, g^*_{NIC}, PY, PI, β and π_{PI}. The endogenous variables are S, I, NIC, NPT, y, g_{GVA}, and g_{GDP}. The lagged endogenous variables are S_{-1}, NIC_{-1}, NPT_{-1}, and y_{-1}

Overall growth in capacity output can be seen to depend on the following factors:

(a) Investible resources: The level of S and NIC relative to income Y as captured by their growth rates. The higher the level of investible resources relative to income, the higher would be growth rate, given other things.

(b) Differential price effect: If prices of investment goods are rising less slowly that the overall income, for the same volume of nominal savings, a relatively larger volume of real capital is generated compared to a situation where the two deflators are moving in tandem.

(c) Sectoral allocation of investment: Sectoral investment can be affected at least partly by policy. We expect that for a given level of investible resources, in the short run, the higher is the allocation to the sectors that have lower capital-output (higher output-capital ratios), the higher will be the aggregate growth rate.

(d) Incremental Output-capital ratios: This depends on the state of technology in each sector. If output-capital ratios increase due to technological improvements, the higher will be the growth rate for the same level of investible resources. This also depends on the efficiency of capital use which is determined by multiple factors.

(e) Sectoral output shares: The shares of sectoral outputs in total output in respective preceding years also affect the overall growth since it is the weighted sum of sectoral growth rates and the weights are given by the sectoral output shares. Output here refers to GVA.

(f) Finally we note that output-capital ratios are measured in relation to real GVA, where the measure of growth in which one is generally interested in is with

respect to real GDP. This requires relating real GVA growth to real GDP growth by adding the growth of real product taxes net of product subsidies. GVA growth can be translated to GDP growth by using the buoyancy of net product taxes with respect to real GVA. The higher the value of this buoyancy, the higher would be the real GDP growth for any given level of real GVA growth.

Saving, Investment, and Output: 2011-12 to 2014-15

The National Income Accounts for India have undergone major methodological changes when the base year was changed to 2011-12. Several doubts have arisen concerning the new series. The Central Statistical Organization has not yet taken the series backwards. Furthermore, due to these major methodological changes, simple splicing does not provide comparable series prior to 2011-12. The CSO has however provided estimates for saving and investment 2011-12 onwards consistent with the new series with sectoral allocation of gross capital formation. Our analysis is based on these series.

Table 1: Aggregate Saving and Investment Ratios: New (2011-12 base) Series

Item	2011-12	2012-13	2013-14	2014-15	2015-16
Gross savings to GDP ratio at current prices	34.65	33.81	33.04	32.96	NA
Net Capital Inflow to GDP ratio at current prices	4.31	4.80	1.65	1.28	NA
Gross capital formation to GDP ratio at current prices*	38.95	38.62	34.70	34.24	NA
Gross capital formation to GDP ratio at current prices**	39.58	38.26	34.66	34.09	32.61
GVA growth at 2011-12 prices	NA	5.43	6.29	7.08	7.30
GDP growth at 2011-12 prices	NA	5.62	6.64	7.24	7.57
GDP deflator based inflation rate		7.85	6.23	3.30	0.99
GCF deflator based inflation rate		5.70	3.76	2.80	-1.62

Source: National Income Accounts: MOSPI (First revised estimates of national income, consumption expenditure, saving and capital formation, 2014-15, released January 29, 2016.

Note: *As per Statement 1.1

** As per Statement 5.

Table 1 indicates that saving as well the investment ratios have fallen since 2011-12 but real growth rates have increased[iii]. This trend is reflected in the lowering of the capital-output ratio (Appendix 1).We also note that the inflation rate based on the GCF deflator is lower than that for GDP for each year during 2012-13 to 2015-16. In

estimating the potential growth rate, a call will have to be taken as the appropriate capital-output ratio that should be used for the estimation of potential growth.

Table 2 gives sectoral shares in investment for the period 2011-12 to 2014-15 at constant 2011-12 prices. In terms of the average investment share over the period 2011-12 to 2014-15, the highest share of investment is in financial, real estate, and professional services at 25.5 percent, followed by manufacturing at 18 percent, and trade, hotels, transport, storage, storage, and communications at 16.7 percent.

Table 2: Sectoral Shares in Investment (Gross Capital Formation) at 2011-12 Prices

Sectors	2011-12	2012-13	2013-14	2014-15	Average (2011-12 to 2014-15)
1. Agriculture, forestry and fishing	8.6	7.6	8.1	7.1	7.8
2. Mining and quarrying	2.1	2.3	4.0	3.3	2.9
3. Manufacturing	19.2	18.4	17.4	16.9	18.0
4. Electricity, gas, water supply and other utility services	9.6	9.1	8.6	9.2	9.1
5. Construction	7.2	7.7	5.5	5.4	6.5
6. Trade, hotels, transport, storage, and communications	14.1	18.0	16.8	18.0	16.7
7. Financial, real estate, and professional services	26.8	24.8	25.9	24.6	25.5
8. Public administration, defence, and other services	12.4	12.1	13.8	15.4	13.4
Total	100.0	100.0	100.0	100.0	100.0

Source: Basic Data: National Income Accounts, CSO, MOSPI.

Table 3 gives incremental output-capital ratios. We notice that the output-capital ratio has been increasing over the period or equivalently that the capital-output ratio has been falling. This is especially so for sectors whose share in total investment has increased. For example, the sectoral share in investment as well as the output-capital ratio has increased particularly in two service sectors namely, Trade, hotels, transport, storage, and communication, and Public administration, defence, and other services (Table 2 and Table 3).

Table 3: Incremental Output-Capital Ratios: (Change in GVA to Gross capital Formation) at 2011-12 Prices

Sector	2012-13	2013-14	2014-15	Average (2012-13 to 2014-15)	Maximum
1. Agriculture, forestry and fishing	0.089	0.230	-0.015	0.101	0.230
2. Mining and quarrying	-0.017	0.056	0.246	0.095	0.246
3. Manufacturing	0.138	0.142	0.144	0.141	0.144
4. Electricity, gas, water supply and other utility services	0.017	0.031	0.049	0.032	0.049
5. Construction	0.019	0.194	0.185	0.133	0.194
6. Trade, hotels, transport, storage, and communications	0.227	0.210	0.253	0.230	0.253
7. Financial, real estate, and professional services	0.175	0.190	0.220	0.195	0.220
8. Public administration, defence, and other services	0.104	0.102	0.214	0.140	0.214
Total GVA at basic prices	0.132	0.158	0.178	0.156	0.178

Source: Basic Data: National Income Accounts, CSO, MOSPI.

In 2014-15, except for two sectors, namely agriculture and construction, for all other sectors, the 2014-15 incremental output-capital ratios are the highest. In the case of agriculture, it is negative because of the effect of a deficient monsoon. In the case of construction, it is slightly lower than its maximum value. In the calculation of potential growth rate, therefore, we propose to use the average incremental output-capital ratio for the concerned period. Agriculture is subject to volatility depending on adequate or deficient monsoons, and it is best to estimate its potential at an average so as to be consistent with a normal monsoon year. For all other sectors, we propose to use the maximum values of the incremental output capital ratios during 2012-13 to 2014-15.

Table 4 gives sectoral GVA growth rates for 2012-13 to 2014-15 with reference to the 2011-12 base national income accounts. The highest growth rates maintained over the three years are for the two main service sectors, namely, trade, hotels, transport, storage, and communications and financial, real estate, and professional services.

Table 4: Sectoral GVA Shares and Growth Rates (2011-12 Prices)

Sectors	Shares in GVA			Growth Rates		
	2012-13	2013-14	2014-15	2012-13	2013-14	2014-15
Agriculture, forestry and fishing	17.84	17.48	16.29	1.5	4.2	-0.2
Mining and quarrying	3.04	2.94	3.05	-0.5	3.0	10.8
Manufacturing	17.50	17.39	17.14	6.0	5.6	5.5
Electricity, gas, water supply and other utility services	2.25	2.21	2.23	2.8	4.7	8.0
Construction	9.15	9.01	8.79	0.6	4.6	4.4
Trade, hotels, transport, storage, and communications	18.13	18.38	18.85	9.7	7.8	9.8
Financial, real estate, and professional services	19.61	20.30	20.97	9.5	10.1	10.6
Public administration, defence, and other services	12.49	12.28	12.69	4.1	4.5	10.7
Total GVA at basic prices	100.00	100.00	100.00	5.4	6.3	7.1

Source (Basic Data): National Income Accounts, CSO.

Table 5 gives sectoral contribution to the aggregate GVA growth. Three services sectors trade, hotels, transport, storage, and communication, financial, real estate and professionals services and public administration, defense, and other services account for more than 70 percent of the overall growth and the contribution of manufacturing has been in the range of 13 to 19 percent during 2012-13 to 2014-15.

Table 5: Sectoral Contribution to Overall GVA Growth

Sectors	Percent per Annum			Percent Share of Contribution in Total GVA Growth		
	2012-13	2013-14	2014-15	2012-13	2013-14	2014-15
Agriculture, forestry and fishing	0.3	0.8	0.0	5.1	12.2	-0.6
Mining and quarrying	0.0	0.1	0.3	-0.3	1.5	4.4
Manufacturing	1.1	1.0	0.9	19.4	15.4	13.0
Electricity, gas, water supply and other utility services	0.1	0.1	0.2	1.2	1.7	2.8
Construction	0.1	0.4	0.4	1.1	6.8	5.6
Trade, hotels, transport, storage, and communications	1.7	1.4	1.8	31.0	22.4	25.4
Financial, real estate, and professional services	1.8	1.9	2.1	32.9	31.0	30.2
Public administration, defence, and other services	0.5	0.6	1.3	9.5	9.0	19.1
Total GVA at basic prices	5.4	6.3	7.0	100.00	100.00	100.00

Source (Basic Data): National Income Accounts, CSO

Using 2014-15 values for all the relevant parameters, we have confirmed that the model generates a GVA growth of 7.1 percent in 2014-15, that is, it estimates the actual growth rate for 2014-15.

Characteristics and Estimation of the Base Run

We now construct a base run for the period from 2015-16 to 2029-30 in order to isolate the influence of different factors either individually or in combination. Inflation rates for both the GCF and the GDP deflators are kept at 4 percent per annum consistent with the mid-point of the target range of inflation rate of 2-6 percent. Keeping these equal in the base run is with a view to highlighting the impact of the differential rates in the simulations. The base run is characterized by the following assumptions.

1. The sectoral investment ratios are kept constant at 2014-15 levels.
2. The incremental output-capital ratios are taken at 2014-15 levels which are also the maximum except for agriculture and construction. For agriculture, we take the average value. For construction, we take the maximum value.
3. For the buoyancy of net product taxes with respect to GVA, measured using variables at both current and constant prices, we use the actual buoyancy for 2014-15 and 2015-16 and then keep it at 1 for the remaining forecast period.

4. The nominal saving growth rate is kept at actual levels for 2014-15 and 2015-16 and at 12.5 percent for the remaining period.
5. The net capital inflow is grown at 12.5 percent from 2016-17 onwards. This gives a level of net capital inflow of a little less than 1.3 percent of GDP which may be considered as sustainable. [See, Rangarajan and Misra (2013) and Rangarajan (*The Hindu*, May 2016)]

Table 6: Potential Growth Simulations: Base Run

Year/Unit of measure-ment	Nominal growth rate of gross savings	Saving rate	Net capital inflow rate	Investment rate	GCF deflator inflation rate	GDP deflator inflation rate	Buoyancy of NPT wrt GVA	GVA growth rate	GDP growth rate
	percent per annum	Ratio to GDP at current prices			percent per annum		Number	percent per annum	
2014-15	10.5	32.9	1.3	34.1	2.80	3.30	1.3	7.4	7.6
2015-16	8.4	32.7	1.3	33.9	-1.62	0.99	1.5	7.7	8.0
2016-17	12.5	32.7	1.3	34.0	1.00	4.00	1.0	8.0	8.0
2017-18	12.5	32.8	1.3	34.0	4.00	4.00	1.0	8.0	8.0
2018-19	12.5	32.8	1.3	34.1	4.00	4.00	1.0	8.0	8.0
2019-20	12.5	32.9	1.3	34.2	4.00	4.00	1.0	8.0	8.0
2020-21	12.5	32.9	1.3	34.2	4.00	4.00	1.0	8.0	8.0
2021-22	12.5	33.0	1.3	34.3	4.00	4.00	1.0	8.0	8.0
2022-23	12.5	33.0	1.3	34.3	4.00	4.00	1.0	8.0	8.0
2023-24	12.5	33.1	1.3	34.3	4.00	4.00	1.0	8.1	8.1
2024-25	12.5	33.1	1.3	34.4	4.00	4.00	1.0	8.1	8.1
2025-26	12.5	33.1	1.3	34.4	4.00	4.00	1.0	8.1	8.1
2026-27	12.5	33.1	1.3	34.4	4.00	4.00	1.0	8.1	8.1
2027-28	12.7	33.2	1.3	34.5	4.00	4.00	1.0	8.1	8.1
2028-29	12.7	33.3	1.3	34.6	4.00	4.00	1.0	8.1	8.1
2029-30	12.5	33.3	1.3	34.6	4.00	4.00	1.0	8.1	8.1

Source: Authors' estimates.

As compared to actual GDP growth rates of 7.3 percent and 7.6 percent for 2014-15 and 2015-16, the estimated potential GDP growth rates are 7.6 percent and 8 percent for these two years. Since the excess of potential over actual growth rates is very small, there is not much scope for increasing stimulus in the economy at the present juncture. The potential growth rate increases to 8.1 percent in the base run.

Simulations and Policy Implications

Using the base run as the benchmark, we consider the effects of specified changes individually as summarized in Table 7.

Table 7: Simulation Designs

Simulation	Description
1	A 1 percent point wedge between inflation rates for gross capital formation and gross domestic product is introduced. The former is lowered to 3.5 percent and the latter is increased to 4.5 percent.
2	The growth rate of nominal saving is increased progressively from 12.5 percent to 16 percent. This reflects the likely positive impact of India's demographic dividend. It leads to a saving rate close to the peak already achieved in 2007-08.
3	Technological innovation leading to productivity growth implying that higher incremental output-capital is introduced. It is done for two sectors, viz. manufacturing and financial and real estate and business services, trade, hotels, transport, storage and communications where the incremental output-capital ratios are increased by given margins.
4	The buoyancy of net product taxes with respect to GVA is increased to 1.2

Table 7 summarizes the results of selected changes. The basic features of the simulations are described below.

Simulation 1: The implicit price deflators differ for gross capital formation vis-à-vis the overall GDP deflator. In particular, a wedge of 1 percent point is introduced between the inflation rates for investment goods as compared the overall GDP from 2017-18 to 2029-30. The GCF deflator based inflation is kept at 3.5 percent while the GDP deflator based inflation is kept at 4.5 percent for this period. A lower GCF deflator relative to the GDP deflator implies that for the same amount of investment in real terms, relatively lower amount of sacrifice in real terms of consumption is needed.

Simulation 2: The growth rate of saving is progressively increased from 13 percent per annum to more than 16 percent throughout the period from 2017-18 to 2029-30, resulting in an increase in the saving rate from 32.3 percent to 38.3 percent of GDP in 2029-30[iv]. Savings rate of close to 38 percent were achieved in 2007-08 as per the 2004-05 base GDP series.

Simulation 3: Improvement in productivity is introduced by changing the incremental output-capital ratio. In particular, the incremental output-capital ratio for manufacturing is increased progressively from 0.15 in 2016-17 to 0.20 in 2029-30.

Simulation 4: The buoyancy of net indirect taxes with respect to GVA is kept at 1.2 from 2017-18 as compared to the base run where it is kept at 1 for this period. A buoyancy level of higher than 1 of indirect taxes will ensure a progressively increasing tax-GDP ratio which is required to finance much-needed expenditures on social sectors. The Economic Survey 2015-16 has also noted that India's tax-GDP ratio is less than comparable benchmarks by at least 3-4 percent points.

The impact of these changes on the GDP growth rate is summarized in Table 8.

Table 8: Growth of GDP under Alternative Policy Configurations

Year/Unit of measurement	**Base Run**	**Simulation 1**	**Simulation 2**	**Simulation 3**	**Simulation 4**
Changes introduced	As in Table 6	Differential GCF and GDP deflators	Growth rate of saving	Output-capital ratio	Buoyancy of net indirect taxes
2014-15	7.6	7.6	7.6	7.6	7.6
2015-16	8.0	8.0	8.0	8.0	8.0
2016-17	8.0	8.0	8.0	8.0	8.0
2017-18	8.0	8.0	8.0	8.0	8.1
2018-19	8.0	8.1	8.1	8.0	8.1
2019-20	8.0	8.1	8.1	8.1	8.1
2020-21	8.0	8.2	8.2	8.1	8.2
2021-22	8.0	8.2	8.3	8.2	8.2
2022-23	8.0	8.2	8.4	8.2	8.2
2023-24	8.1	8.3	8.6	8.2	8.2
2024-25	8.1	8.3	8.7	8.3	8.2
2025-26	8.1	8.3	8.9	8.3	8.2
2026-27	8.1	8.4	9.0	8.4	8.2
2027-28	8.1	8.4	9.2	8.5	8.3
2028-29	8.1	8.4	9.4	8.5	8.3
2029-30	8.1	8.5	9.6	8.6	8.3

Source: Authors' calculations.

The highest positive impact on the growth rate comes from increasing the saving rate. This is followed by the positive effect of differential prices for investment goods vis-

à-vis the overall GDP. Increasing productivity and keeping buoyancy of net product taxes at 1.2 also has a positive impact.

In the context of current policy formulation, some of the implications are very clear. First, the steady fall in the saving rate as exhibited by the savings-data for the period from 2011-12 to 2014-15 was accompanied by an increase in the output-capital ratio. This may mean better capacity utilization although there is no direct evidence of this. If the trend of falling saving rate continues, it will be most detrimental for India's potential growth rate. Raising the savings rate will also mean control over the fiscal deficit since public savings is a component of savings.

Improving productivity would require sustained effort on the part of the government in terms of improving ease of doing business, facilitating better supply chains (through GST) and overcoming infrastructure deficiency. It will also require sustained action on the part of businesses relating to innovations, better supply chain management and training. It may further be noted that under all scenarios, the share of industry would be going down and that of services will increase.

Table 9: Share of Industry under Alternative Policy Configurations

Fiscal year	Base	Scenario 1	Scenario 2	Scenario 3	Scenario 4
2014-15	31.6	31.6	31.6	31.6	31.6
2015-16	31.1	31.1	31.1	31.1	31.1
2016-17	30.7	30.7	30.7	30.7	30.7
2017-18	30.3	30.3	30.3	30.3	30.3
2018-19	29.9	29.9	29.9	29.9	29.9
2019-20	29.6	29.6	29.6	29.6	29.6
2020-21	29.3	29.2	29.2	29.3	29.3
2021-22	29.0	28.9	28.9	29.0	29.0
2022-23	28.7	28.7	28.7	28.8	28.7
2023-24	28.4	28.4	28.4	28.6	28.4
2024-25	28.2	28.2	28.1	28.5	28.2
2025-26	28.0	27.9	27.9	28.3	28.0
2026-27	27.8	27.7	27.7	28.2	27.8
2027-28	27.6	27.5	27.5	28.2	27.6
2028-29	27.4	27.4	27.3	28.1	27.4
2029-30	27.2	27.2	27.1	28.1	27.2

Source: Authors' calculations.

In interpreting these results, certain caveats should be kept in mind. First, while we have focused on potential growth, we have not examined the influence of demand side considerations, which will eventually determine the actual growth around a path describing potential growth. We have also assumed that the output-capital ratios are constant for the period under consideration or in selected sectors they change very slowly.

CONCLUDING OBSERVATIONS

In this paper, a methodological framework for estimating India's potential future growth has been proposed. This approach focuses on the supply side and the determination of the growth path of capacity output up to the period 2029-30. In particular, we highlight the relative roles of (a) growth of investible resources comprising domestic savings and net capital inflow, (b) differential prices of investment goods vis-à-vis consumption goods and services, (c) sectoral incremental capital-output ratios, (d) the changing weights of sectoral outputs in total output due to sectoral growth rate differentials, and (e) the buoyancy of net product taxes. We derive growth paths of India's potential growth under alternative assumptions with a view to considering policy options in the present for driving the economy towards a suitable future growth path. In interpreting these results, certain caveats should be kept in mind. First, while we have focused on potential growth, we have not examined the influence of demand side considerations, which will eventually determine the actual growth around a path describing potential growth.

Improving productivity would require sustained effort on the part of the government in terms of improving ease of doing business, facilitating better supply chains (through GST) and overcoming infrastructure deficiency. It will also require sustained action on the part of businesses relating to innovations, better supply chain management and training.

The most potent growth augmenting source remains an uplift of the domestic saving rate. The phase of high growth that India achieved during three consecutive years, 2005-06, 2006-07, and 2007-08 was characterized by (a) high savings and investment rates and (b) low incremental capital-output ratio. In these three years, real growth rate for GDP at 2004-05 market prices were, respectively, 9.3, 9.3, and 9.8 percent. Although growth in exports at constant prices was at 26.1 and 20.4 percent in 2005-06 and 2006-07 respectively, it fell to 5.9 percent in 2007-08, which was the year of the highest growth among the three years. In all the three years, real imports grew at rates higher than the exports, so that the net exports were negative. The high growth achievement was therefore mainly due to the high saving and investment rates and lower incremental capital-output ratios. In these three years, the saving rates relative to GDP, both measured at current prices, were 33.4, 34.6, and 36.8 percent respectively. The investment rates, measured at 2004-05 prices, were 34.9, 36.2 and 39 percent. The ICORs at 2004-05 prices were respectively, 3.9, 3.6, and 3.8. In contrast, in the current scenario, the saving and investment rates have fallen and the ICOR is higher. In 2015-

16, we estimate it to be 4.4, which is the lowest in recent years but still higher than the 2005-08 levels. Although export growth is currently negative, imports have fallen even faster, leading to net exports contributing positively to GDP growth in 2013-14 and 2014-15 although by a very small margin. Yet in a scenario, when exports are falling or show low growth, reliance has to be more on domestic consumption. In such a situation it will be quite a challenge to uplift the saving rate significantly. This will require lowering of government's revenue deficit from its current levels. The key to higher growth would therefore be lower ICOR. Policies that lead to higher productivity would therefore support higher growth in the short term. However over the medium term, high growth can be sustained only by raising the savings and investment rate.

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APPENDIX 1

Incremental Capital-Output Ratios with Respect to Gross Capital Formation and Gross Fixed Capital Formation at 2011-12 Prices

Serial No.	Sector / With respect to Gross Capital Formation	2012-13	2013-14	2014-15	Average (2012-13 to 2014-15)	Minimum
1	Agriculture, forestry and fishing	11.2	4.3	-65.0	-16.5	-65.0
2	Mining and quarrying	-57.4	17.8	4.1	-11.8	-57.4
3	Manufacturing	7.2	7.0	7.0	7.1	7.0
4	Electricity, gas, water supply and Other utility services	58.2	32.5	20.6	37.1	20.6
5	Construction	52.9	5.1	5.4	21.2	5.1
6	Trade, hotels, transport, storage, and communications	4.4	4.8	4.0	4.4	4.0
7	Financial, real estate, and professional services	5.7	5.3	4.5	5.2	4.5
8	Public administration, defense, and other services	9.6	9.8	4.7	8.0	4.7
9	Total GVA at basic prices	7.6	6.3	5.6	6.5	5.6
	With respect to Gross Fixed Capital Formation* (at 2011-12 prices)					
10	Total GVA at basic prices	6.3	5.3	4.6	5.4	4.6
11	GDP at constant (2011-12) market prices	6.1	5.0	4.5	5.2	4.5

Source: National Income Accounts: MOSPI (First revised estimates of national income, consumption expenditure, saving and capital formation, 2014-15), released January 29, 2016.

Note: * Sector-wise gross fixed capital formation data are not yet available in the 2011-12 base series.

APPENDIX 2

$GDP = GDP_{-1}[(1 + g_{GDP})]$ and $y = y_{-1}[(1 + g_{GVA})]$

GDP = y+NPT

$$GDP_{-1}[(1 + g_{GDP})] = y_{-1}[(1 + g_{GVA})] + \{NPT_{-1}[1 + \beta g_{GVA}]\}$$

$$g_{GDP} = \frac{[GDP_{-1}[(1 + g_{GDP})] + \{NPT_{-1}[1 + \beta\, g_{GVA}]\} - GDP_{-1}]}{GDP_{-1}}$$

$$\mathrm{g_{GDP}} = \frac{[\{y_{-1} + NPT_{-1}\} + g_{GVA}\{y_{-1} + \beta NPT_{-1}\} - GDP_{-1}]}{GDP_{-1}}$$

$$\mathrm{g_{GDP}} = \frac{g_{GVA} * [\mathrm{y_{-1}} + \beta \mathrm{NPT_{-1}}]}{\mathrm{GDP_{-1}}}$$

APPENDIX 3

From equation (7),
$\Delta y_i = \alpha_i * C_i(I/PI)$

Substituting the value of I from equation (1),
$\Delta y_i = \alpha_i * C_i[\{S + NIC\}/PI]$

Using equation (8), where growth rate of GVA is referred to as g_{gva}, and replacing C by C^*
$g^i_{GVA} = \left(1/_{y^i_{-1}}\right) \alpha_i * C^*_i * [\{S + NIC\}/PI]$

Taking a weighted average of sectoral GVA growth rates,
$g_{GVA} = \sum \left(y^i_{-1}/_{y_{-1}}\right) * \left(1/_{y^i_{-1}}\right) \alpha_i * C^*_i [\{S + NIC\}/PI]$
$g_{GVA} = \left(1/_{y_{-1}}\right) \sum \alpha_i * C^*_i * [\{S + NIC\}/PI]$

From equation (12),

$$g_{GDP} = \frac{\{\left(1/_{y_{-1}}\right) \sum \alpha_i * C^*_i [\{S + NIC\}/PI] * [y_{-1} + \beta NPT_{-1}]\}}{GDP_{-1}}$$

Where y is real GVA, GDP is real GDP and S and NIC are at current prices.
We can write $GDP_{-1} = Y_{-1} / PY_{-1}$ and $PI = PI_{-1}[(1 + \pi_{PI})]$

Where Y is GDP at current prices and PY is the GDP deflator. π_{PI} is the rate of inflation of the investment goods deflator. Thus,

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C^*_i \left\{\frac{(S + NIC)}{PI_{-1}(1 + \pi_{PI})}\right\}\right] * \left[\frac{PY_{-1}}{Y_{-1}}\right] * (y_{-1} + \beta\, NPT_{-1})$$

Bringing the $(S + NIC) / [PI_{-1}(1+\pi_{PI})]$ term outside the summation sign since it is common for all sectors, we can write

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C^*_i\right] * \left(\frac{S + NIC}{Y_{-1}}\right) * \left[\frac{PY_{-1}}{PI_{-1}}\right] * \left[\frac{1}{1 + \pi_{PI}}\right] * (y_{-1} + \beta\, NPT_{-1})$$

Using growth rates of nominal savings, g_s and nominal net inflow of capital, g_{nic}, we have

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C_i^*\right] * \left[\frac{S_{-1}\,[1 + g_s] + NIC_{-1}\,[1 + g_{nic}]}{Y_{-1}}\right] * \left[\frac{PY_{-1}}{PI_{-1}}\right] * \left[\frac{1}{1 + \pi_{PI}}\right] * (y_{-1} + \beta\, NPT_{-1})$$

Further, $s_{-1} = {S_{-1}}/{Y_{-1}}$ and $nic_{-1} = {NIC_{-1}}/{Y_{-1}}$. Therefore, we have

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C_i^*\right] * [s_{-1}(1 + g_S) + nic_{-1}(1 + g_{NIC})] * \left[\frac{PY_{-1}}{PI_{-1}}\right] * \left[\frac{1}{1 + \pi_{PI}}\right] * (y_{-1} + \beta\, NPT_{-1})$$

$g_S = (1 + \pi_{PI} + g_S^*)$ and $g_{NIC} = (1 + \pi_{PI} + g_{NIC}^*)$

Where g_s is the nominal growth rate of savings and g^*_s is the real growth rate of savings. Similarly, g_{nic} is the nominal growth rate of net inflow of capital and g^*_{nic} is the real growth rate of net inflow of capital. So, we obtain

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C_i^*\right] * \left[\frac{PY_{-1}}{PI_{-1}}\right] * \left[s_{-1}\left(\frac{1 + \pi_{PI} + g_S^*}{1 + \pi_{PI}}\right) + nic_{-1}\left(\frac{1 + \pi_{PI} + g_{NIC}^*}{1 + \pi_{PI}}\right)\right] * (y_{-1} + \beta\, NPT_{-1})$$

$$g_{GDP} = \left[\frac{1}{y_{-1}} \sum \alpha_i * C_i^*\right] * \left[\frac{PY_{-1}}{PI_{-1}}\right] * \left[s_{-1}\left[1 + \frac{g_S^*}{(1 + \pi_{PI})}\right] + nic_{-1}\left[1 + \frac{g_{NIC}^*}{(1 + \pi_{PI})}\right]\right] * (y_{-1} + \beta\, NPT_{-1})$$

[i] Ideally, we need to work with fixed capital formation. Adjustments are needed to account for investment in valuables and inventories, capital consumption, and errors and omissions. Thus, investment in net fixed capital formation is given by:
NI = [S + NIC – CFC – NFC]
Here, NFC includes investment in valuables, inventories, and adjustment for errors and omissions.

[ii] We use this term to indicate maximum attainable real growth for a given level of real savings/ investment. This would be consistent with full capacity utilization and derived by using the maximum levels of the incremental output-capital ratios for all sectors over a reference period.

[iii] Doubts have been expressed about the reliability of the growth estimates in the new GDP series. [See, Nagaraj, EPW articles]

[iv] Since India is entering into a demographic dividend window where the share of working age population to total population will keep increasing up to 2029-30 and a few years beyond, we expect the growth in nominal saving to keep increasing progressively.

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