

# Impacts of GST reforms on efficiency, growth and redistribution of income in India: A Dynamic CGE Analysis<sup>1</sup>

**Keshab Bhattarai**

Faculty of Business, Law and Politics  
University of Hull  
Hull, England, Yorkshire, HU6 7RX, UK

Goods and service tax (GST) introduced as a 'good and simple tax' on 1 July 2017 by the Modi government is the boldest measure of tax reform so far in India. The major aim of this paper is to evaluate the micro and macro impacts of the goods and services taxes (GST) using a dynamic computable general equilibrium model of the Indian economy. This is an original contribution as no such work is found in the literature. This paper applies a dynamic CGE model calibrated to the micro-consistent input-output data of the Indian economy to assess impacts of GST on the efficiency in allocation of resources among production sectors, growth of income and employment over time, the redistribution of income among households in India. While GST reforms will improve specialization in productions of goods and services among the major economic sectors of India by removing distortions in the production and distribution of goods and services, transparency it brings in the tax system will help to maintain above seven percent continuous growth rate in output, investment and physical capital. It also promotes expansion in human capital and the financial system. Anti-corruption measures including recent demonetization of large denomination notes and digitization of economic transactions along with GST reforms will add to infrastructure including construction and expansion of communication networks, massive electrification, development of rail, road, air and shipping networks. By creating better opportunities for education and training for the younger generation, health services for all continuous reforms in direct and indirect taxes will bring speedier growth of income and employment along with more balanced distribution of income.

Key words: GST, Dynamic CGE, India

JEL classification: C68, E62, D58, O11, O12

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## I. Introduction

India is growing very fast in the last two decades. Millions of people have been out of poverty in this period; rate of poverty declined from about 21 percent to below 7 percent during this period. While there are many bright spots of the speedy growth and development, there are still major challenges in bringing growth to the many people particularly those in rural areas and in the families of poor income groups in many urban areas. A prudent fiscal policy can create opportunities and create more equal distribution of income. Tax reform agenda brought by the Modi government aims to achieve, efficiency in allocation of resources for higher rates of growth of output and employment across various sectors of the economy and to redistribute income so that every individual in the society has access to at least to a minimal satisfactory standard of living (Panagariya (2017)).

The major aim of this paper is to evaluate the micro and macro impacts of the goods and services taxes (GST) using a dynamic computable general equilibrium model of the Indian economy. This model not only captures the current structure of the entire Indian economy but also proves more realistic dynamic evolutionary paths of the economy over many years to come. This is an original contribution as no such work is found in the literature. It is an excellent framework to evaluate policy alternatives in a computer generated model economy. This exercise also helps to understand the role India plays as a major emerging economy in the world. Section 2 provides time series data based background on the macroeconomic dynamics of the Indian economy. Data were from the IMF. Section 3 explains components of GST. Section 4 has specification of the dynamic CGE model. Benchmarking and calibration of the to the micro-consistent data set is discussed in section 5. Analysis of efficiency, growth and redistribution impacts of reforms based

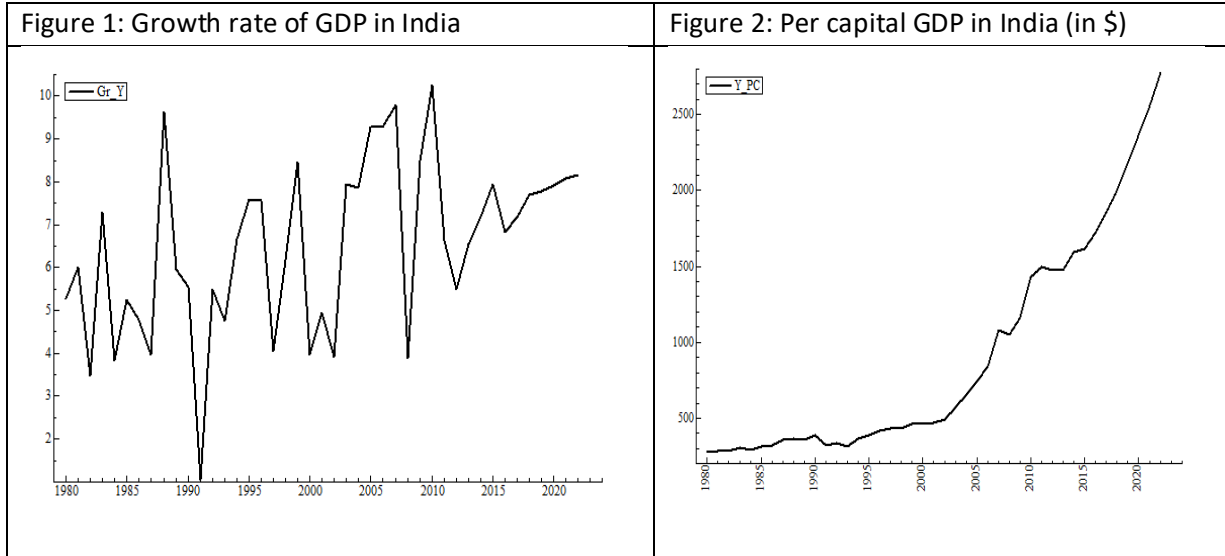
on the dynamic solutions of the DCGE model are given in section 6 followed by conclusions of the study in the last section.

The GST was implemented on 1 July 2017. GST Bill was passed by both houses of the parliament with an amendment of the Constitution in August 2016. Government of India (2017), Roy (2017) and Adhiya (2017) explained how it could be implemented, YouTube channel workshops demonstrated practical steps. Earlier discussion on GST in India started in 2006 (Bagchi and Poddar (2007)). Rao (2010) and Jha (2013) explained how it can fit in the context of fiscal federalism in India. Cnossen (2013), Dubey and Shukla (2016) and Lourduathan and Xavier (2017) explain possibility of its implementation. Despite these no systematic studies have taken place in order to assess the economywide impacts of GST on growth, efficiency of allocation of resources and the redistribution of income. CGE models of Ojha, Pradhan and Ghosh (2013) used a comparative static CGE model based recursive projections argued that physical and human capital need to be complemented by growth in TFP for long run growth. In my knowledge, no dynamic CGE model have been used to analyze dynamic issues relating to the efficiency, growth and redistribution in India.

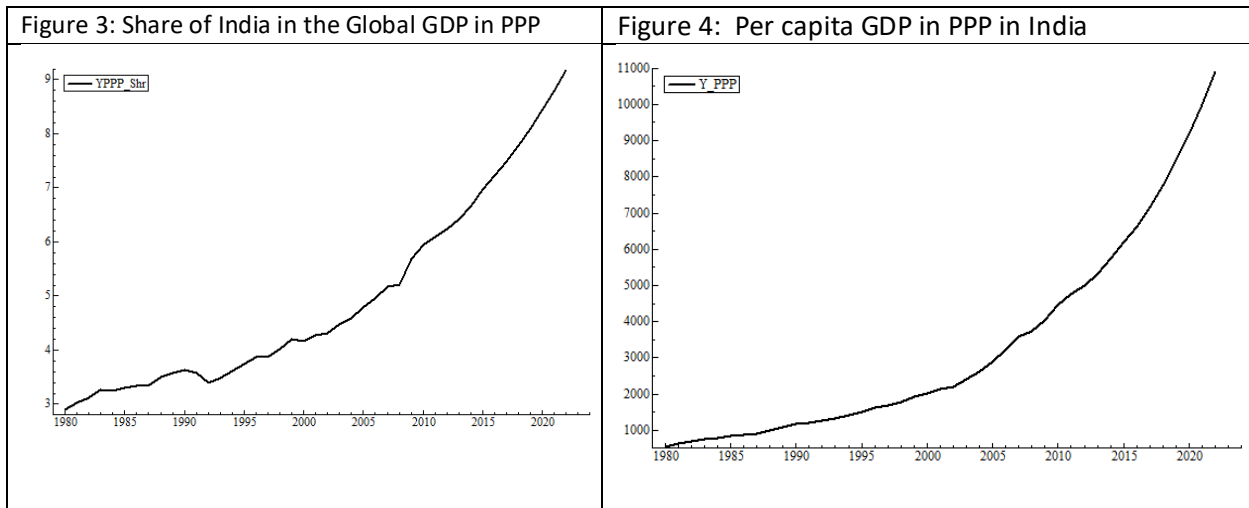
## **II. Background of the Indian Economy**

Growth rate of India has remained very impressive in the last two decades (Figure 1) on average it has been above 6.5 percent since 1990. Liberalisation of the economy and right set of policies have been key factors for such a sustained growth (Ahluwalia (2002), Mallick (2002), Panda and Ganesh-Kumar (2007)). Income per capita also has increased from less than 200 US dollars in 1980s to around 2500 Dollars in 2020 (Figure 2). In terms of PPP India's per capita income will be around 11,000 PPP Dollars (Figure 4) by then. As a result, the share of India in the global economy is gradually rising; now India counts around 8 percent of the global GDP in PPP terms. Given that India is home of about 20 percent

of the global population, there is no reason why this global share could not rise to 20 percent in the next few decades. Speedy growth supported by policy reforms such as the GST can achieve this objective.



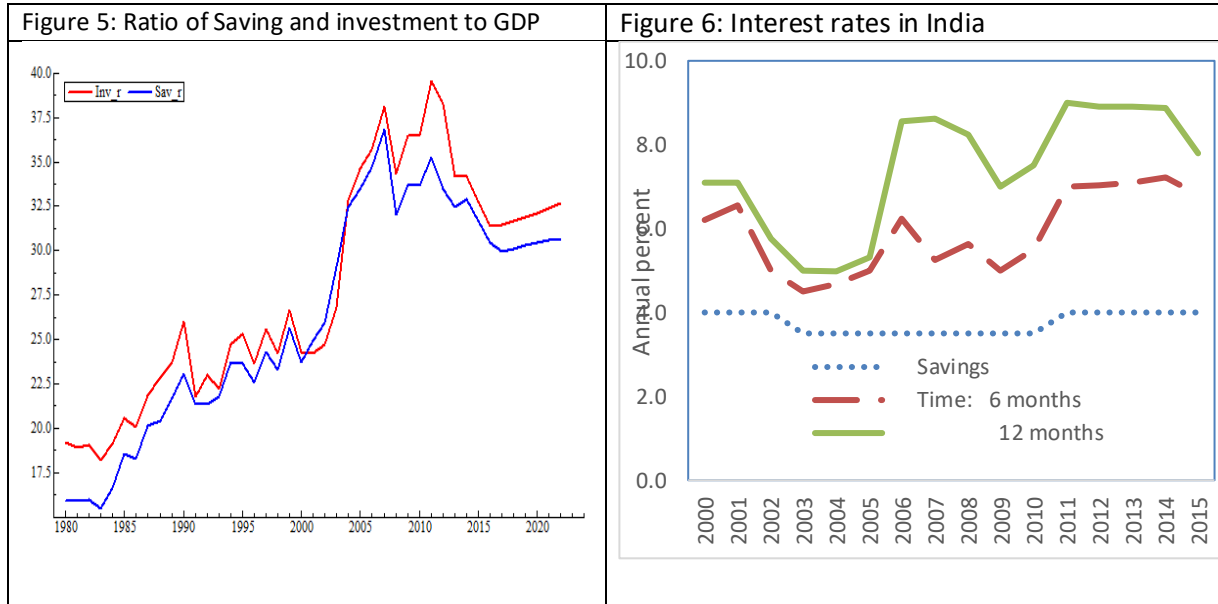
Data source: WEO database Oct 2017, IMF.



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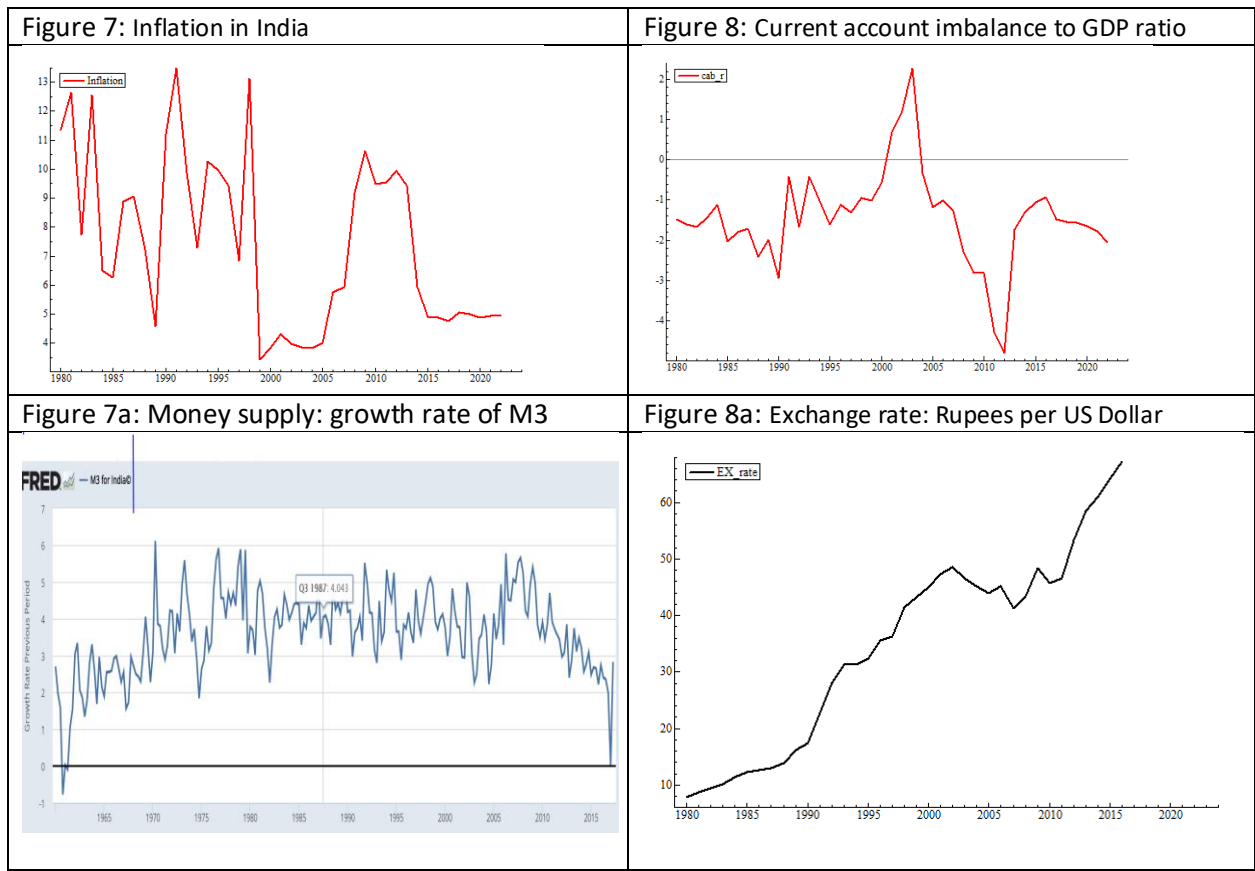
Growth of the economy and per capita income as above were possible because of the steady growth in the ratios of saving and investment to GDP over time (Figure 5). Development of financial institutions and liberalization of banking system helped to mobilize savings in a massive scale. It raised interest to savers (Figure 6) and lowered the cost of capital to the investors. Macroeconomic stability created atmosphere for investment and capital formation. Human

capital was also created through expansion of high quality educational institutions and research in science, technology and engineering. Expansion in health services also has been the source of growth in labour force, particularly the large scale skilled young generation as required by the economy.



Data source: WEO database Oct 2017, IMF

Inflation was the major challenge in 1980 to 2000 but has gradually become more stable due to balanced budget approach and privatization and liberalisation measures adopted by the government (Figure 7). Growth rate of money supply has declined drastically since 2011 (Figure 7a). License Raj was dismantled and exchange rates were allowed to be driven freely by the market (Figure 8a). This helped to solve the BOP problem (Figure 8). Such reforms were appropriate for the long-term investment and India opened the door for FDI and technical innovations.



Data source: WEO database Oct 2017, IMF

It is natural for a developing economy like India to have a rapidly expanding public sector. While it is difficult to raise more revenue from a narrow and still underdeveloped tax base, demand for public funds from infrastructure, health and education and other social services abound. This creates wide gap between revenue and spending, it reached even 10 percent of GDP in mid 1990s (Figure 9). Such unsustainable public finance resulted in accumulation of debt (Figure 10). In recent years more focus has been on reducing the budget deficit to around 3-4 percent of GDP and to trim down the debt GDP ratio. Comprehensive GST reforms can mitigate such imbalances.

Figure 9: Revenue and spending to GDP ratios in India

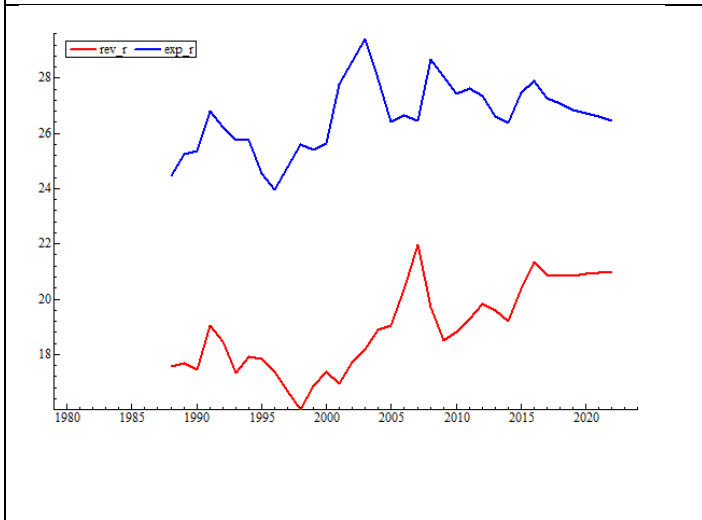
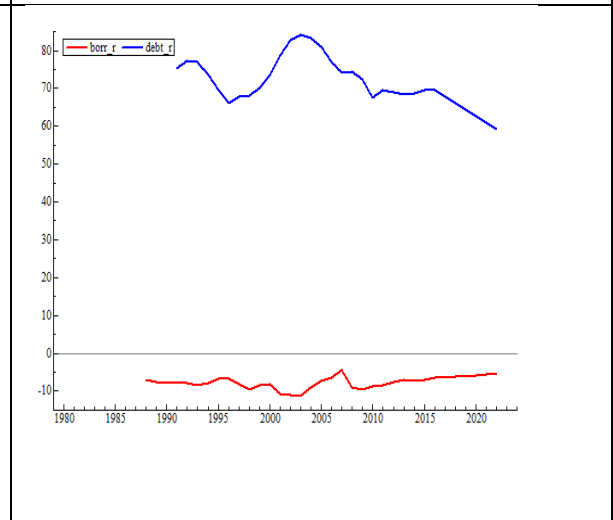


Figure 10: Borrowing and debt to GDP ratios in India



Data source: WEO database Oct 2017, IMF

Another major macroeconomic problem is increasing inequality with the prospects of economic growth across various states (Figure 13) and among different categories of households (Figure 11). Despite impressive growth rates, inequality in the distribution of income is becoming much higher in India than in its neighboring countries (Figure 12).

Figure 11: Distribution of Income in India (WBDI), 2017

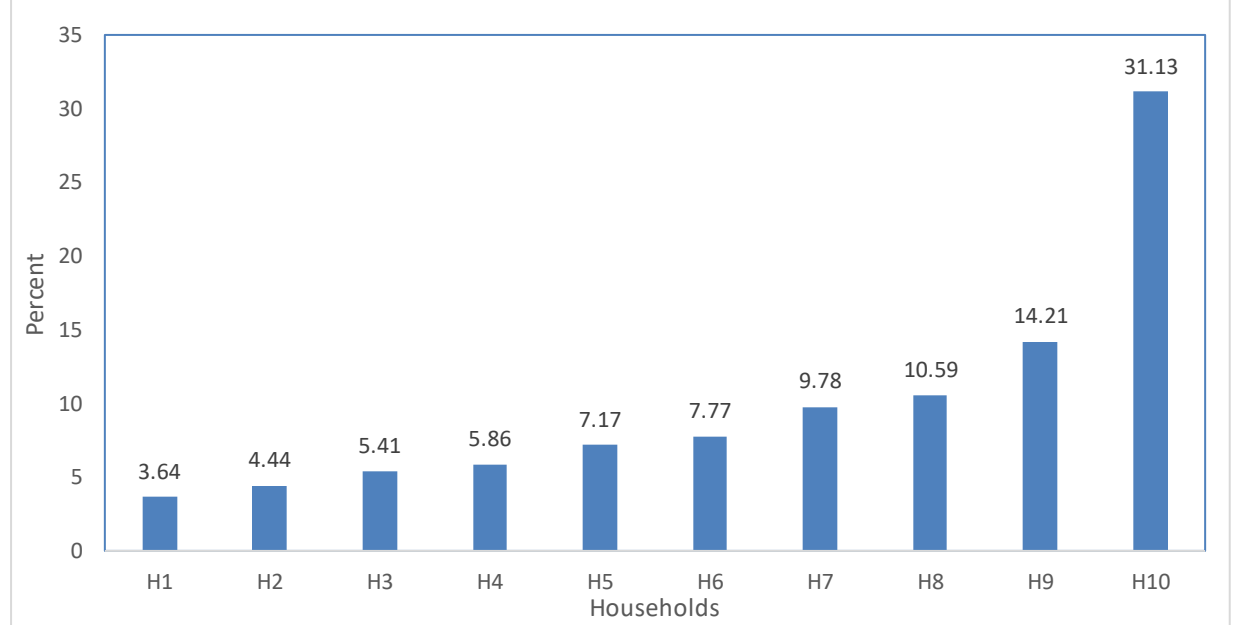
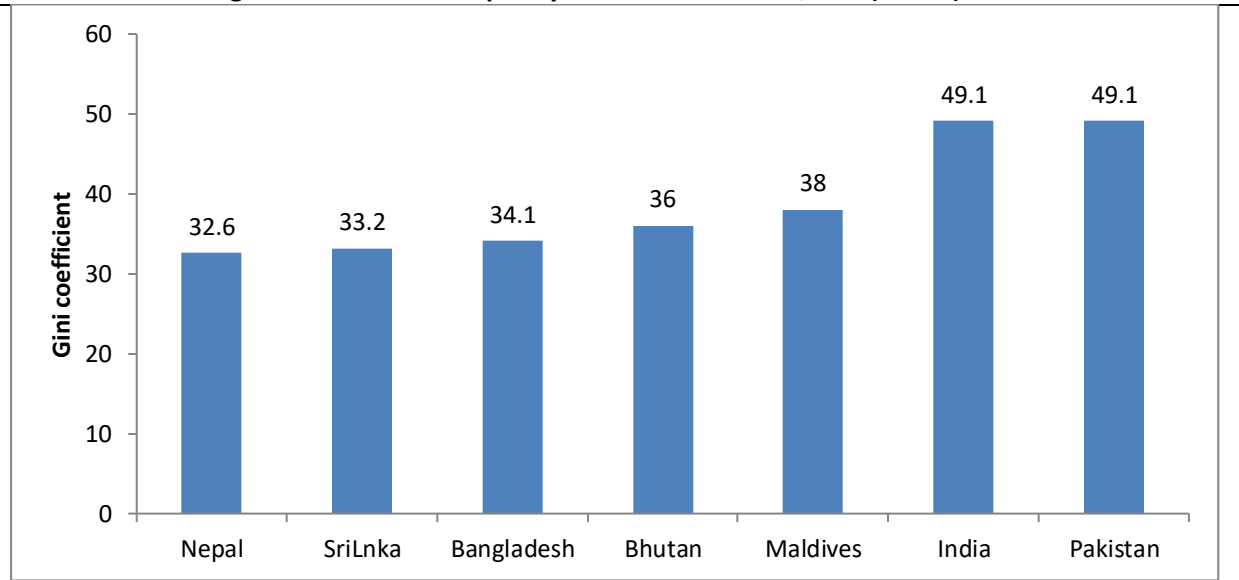


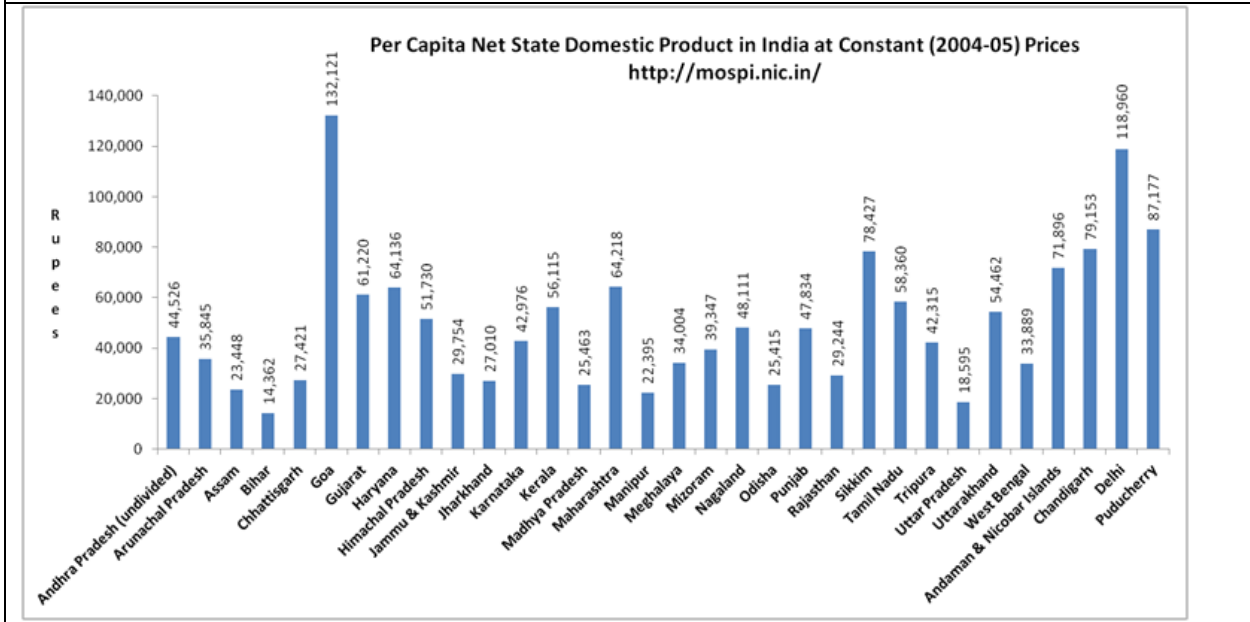
Figure 12: Income Inequality in SAARC countries, Gini (Wider) 2014



Data source: WBDI, Oct 2017, World Bank



Figure 13: Inequality in the standard of living across different states in India



Source: <http://mospi.nic.in/>

Huge gaps exist in per capita income among states of India as seen from Figure 13. While states like Goa and Delhi had 132 and 119 thousand rupees of per capital income it was just 14 thousands in Bihar and 18.5 thousands in the UP. Barriers to trade between provinces created by cascading of so many taxes are to be removed after the implementation of unified CGST, SGST and IGST.

### III. Impacts of GST on Demand and Supply Sides of the Economy

GST was implemented in India on 1 July 2017 and it was the most important policy reform in India since Independence. It is a comprehensive reform of the indirect tax system in India where the central government, 29 state governments and nine union territories have reached a unique agreement and an amendment in the constitution was required so that producers of goods and services became liable to pay sales taxes to the central and state governments simultaneously. It has removed all structural rigidities and extra burdens on consumers because of cascading of taxes.

GST replaces all types of indirect taxes at the central and state levels in spirit of one nation, one tax, one market. GST unifies all indirect taxes making one rate of indirect tax applicable on any commodity through-out the whole country. Central GST (CGST), State GST (SGST) and integrated GST (IGST), Union territory GST (UTGST) are parts of the same GST system. Its built-in mechanism of tax credit system is expected to minimize the tax evasion and tax avoidance problems.

While GST started in France in 1954 its implementation was gradual across countries. Around 160 countries in the world now implement GST (Vasanthagopal, 2011). Like Canada and Brazil India is adopting a dual GST system at the central and state levels. **While the Central GST will replace existing multitude of indirect taxes such as central excise taxes, additional excise duty, service tax, countervailing duty, special additional duty, the state GST will replace state level VAT, entertainment taxes, luxury tax, taxes in lottery, betting and gambling and taxes on advertisement and entry taxes.** According to the Central Board of Excise and Customs of India, a

few indirect taxes such as basic custom duty, taxes on land and buildings and mineral rights and excise on alcoholic liquors and stamp duty are to remain even after the implementation of GST.

GST council has determined GST rates of 0%, 5%, 12%, 18% and 28% on goods and services; a detailed schedule exists for rates applicable specific to goods and services (see the appendix for goods in each category from the CGE Council). It also outlines procedure on how CGST, SGST or IGST or UTGST are paid on sales of goods and services. GST will have wide ranging demand and supply side effects. In general GST will be beneficial to households, business firms and the central governments simultaneously. According to the government of India (2017) households benefit from i) Simpler tax system (ii) Reduction in prices of goods and services due to elimination of cascading (iii) Uniform prices throughout the country (iv) Transparency in taxation system (v) Increase in employment opportunities. Similarly trade and industry may benefit by a (i) Reduction in multiplicity of taxes (ii) Mitigation of cascading/double taxation (iii) More efficient neutralization of taxes especially for exports (iv) Development of common national market (v) Simpler tax regime-fewer rates and exemptions; and the central and state governments benefit from the GST from 1) A unified common national market to boost Foreign Investment and “Make in India” campaign (ii) Boost to export/manufacturing activity, generation of more employment, leading to reduced poverty and increased GDP growth (iii) Improving the overall investment climate in the country which will benefit the development of states (iv) Uniform SGST and IGST rates to reduce the incentive for tax evasion (v) Reduction in compliance costs as no requirement of multiple record keeping<sup>i</sup>.

In a nutshell, the overall tax rates of India now are as shown in Table 1. Direct tax on income varies by categories of income. There is no income tax up to Rs 250,000 of income. Then a 10% tax applies to income between Rs 250, 000-500,000; 20 percent tax to Rs 500, 000-1,000,000 and 30% income tax rate for income above Rs 1,000,000. Thus the direct tax system is progressive. The GST can also be progressive tax with five different rates 0%, 5%, 12%, 18% and 28% applicable according to social optimality level for commodities being sold in the market. While items such as **Jute, fresh meat, fish chicken, eggs, milk, butter milk, curd, natural honey, fresh fruits and vegetables, flour, besan, bread have zero rate GST**, a 28 percent rate GST is applicable in items such as Bidis, chewing gum, molasses, chocolate not containing cocoa, waffles and wafers coated with chocolate, pan masala, aerated water, paint, deodorants, shaving creams, after shave, hair shampoo, dye, sunscreen, wallpaper, ceramic tiles, water heater, dishwasher, weighing machine, washing machine, ATM, vending machines, vacuum cleaner, shavers, hair clippers, automobiles, motorcycles, aircraft for personal use.

<b>Table 1: Tax structure in India</b>					
<b>Direct taxes</b>			<b>Indirect taxes</b>		
<b>Income tax</b>	<b>Tax rate</b>	<b>plus</b>	<b>CGST</b>	<b>GST 2017</b>	<b>Main taxes before GST</b>
<b>Taxable income (Rs)</b>					<b>Central:</b>
<b>250,000</b>	<b>0</b>			<b>5%</b>	<b>Custom duties 0 to 35%</b>
<b>250,000 to 500,000</b>	<b>10%</b>				<b>Central excise 0 to 35%</b>
<b>500,000 to 1,000,000</b>	<b>20%</b>	<b>25,000</b>		<b>12%</b>	<b>Service taxes 0 to 15%</b>
<b>above 1,000,000</b>	<b>30%</b>	<b>125,000</b>			
			<b>SGST</b>	<b>18%</b>	<b>State:</b>
<b>Corporation tax rate</b>	<b>30%</b>				<b>VAT 5 to 15%</b>
<b>Dividend tax</b>	<b>17.00%</b>		<b>IGST</b>		<b>Stamp duties 2%</b>
					<b>(Land revenue)</b>
			<b>UTGST</b>		<b>State excise 0 to 35%</b>
<b>Of the total revenue</b>	<b>56.30%</b>			<b>28%</b>	<b>43.70%</b>

<http://www.cbec.gov.in/htdocs-cbec/customs/cs-tariff2015-16/cst2015-16-idx>

For our counterfactual scenarios we take 12 percent GST on average to be applicable to all goods and services along with 5 percent of income tax across all households. When the existing taxes are replaced in this way they have very positive impacts in the economy.

#### IV. Specification of the dynamic CGE model of India

Indirect taxes impact on efficiency, growth and redistribution by influencing both demand and supply sides of the economy. Neither the traditional econometric models nor the dynamic stochastic general equilibrium (DSGE) models are appropriate tools for analyzing growth, efficiency and redistribution impacts of taxes in an economy. While the main purpose of macro-econometric models is forecasting based on time series data, the DSGE models are concerned in analyzing business cycles imposing nominal and real rigidities in the model. Dynamic CGE models are truly micro-founded macroeconomic models suitable for analysis of growth, efficiency and redistributions as the outcome of dynamic optimization processes of households, firms and the government. Current model is based on Bhattarai (2017a 2017b) and Haughton, Bachman, Bhattarai and Tuerck (2017) and is better than comparative static recursive analysis of Ojha, Pradhan and Ghosh (2013) to analyze dynamic issues of the Indian economy. We also note general discussions on tax and inequality from Bargain and Moreau (2007) or Mirrlees, Adam, Besley, Blundell, Bond, Chote, Gammie, Johnson, Myles and Poterba (2010) in order to improve the understanding of the incidence and burden of taxes in the model economy.

##### **General Equilibrium Impact of Taxes**

Full impact of changes in taxes occurs through several rounds. First round effects start with

the incidence of tax with a reduction (increase) in the household income. It can happen as taxes affect profit of firms. These have impacts on demand for products by households and foreigners and supply of goods and services by firms. Similarly it affects government spending and investment spending. Second round effects occur when the burden of taxes start shifting gradually. It manifests itself as an increase or decrease in prices of commodities, collection of revenues. Final impacts are settled when all burdens shift through-out the economy. The detailed specification of this model that follows has consists of households that maximize the lifetime utility subject to budget constraints, firms maximize profit subject to technology constraints. Exports and imports occur. Revenue and spending may differ in the short run but have to be balanced over the model horizon.

Model contains  $i = 1..38$  states each with  $h = 1....10$  households. Each household in each state receives utility from consumption of goods and leisure. Its objective is to maximise lifetime utility against their life time budget constraints. They receive income supplying labour and capital services to firms which pay them according to the marginal productivity. Lower income households receive transfers from the government which collects revenue by taxing high income households.

$$\text{Max } U_0^{i,h} = \sum_{t=0}^{\infty} \beta^{i,t} U_t^{i,h}(C_t^{i,h}, l_t^{i,h}) \quad (1)$$

Subject to

$$\sum_{t=0}^{\infty} R_{i,t}^{-1} [P_{i,t}(1+t^{i,vc} + t^{i,vc})C_t^{i,h} + w_{i,t}(1-t_{i,l})l_t^{i,h}] = \sum_{t=0}^{\infty} [(1-t_l)w_{i,t}L_t^{i,h} + (1-t_{i,k})r_{i,t}K_t^{i,h} + TR_t^{i,h} + TRS_t^{i,h}] \quad (2)$$

where  $C_t^{i,h}$ ,  $l_t^{i,h}$  and  $L_t^{i,h}$  are respectively composite consumption, leisure and labour supplies of

household  $h$  in period  $t$  in country  $i$ ,  $R_{i,t} = \prod_{s=0}^{t-1} \frac{1}{1+r_{i,s}}$  is a discount factor;  $r_{i,t}$  represents the real

interest rate on assets at time  $s$ ;  $t^{i,vc}$  is CGST on consumption,  $t^{s,vc}$  is SGST,  $t^{i,l}$  is labour income taxes, and  $K_t^{i,h}$  is the composite consumption, which is composed of sectoral consumption goods,  $P_{i,t}$  is the price of composite consumption (which is based on goods' prices), i.e.  $P_{i,t} = \mathcal{G} \prod_{i=1}^n \alpha_{i,g} p_{i,,g,t}^{\alpha_{i,g}}$ , and  $C_t^{i,h} = \prod_{i=1}^n C_{i,,g,t}^{\alpha_i^h}$  and the model has eleven goods,  $g = 1...33$ .

Industries of each state in the Indian economy are represented by firms that combine both capital and labour input in production and supply goods and services to the market.

$$\Pi_{j,g,t}^y = \left[ \left( (1 - \delta_{i,g}^e) PD_{i,,g,t}^{\frac{\sigma_y - 1}{\sigma_y}} + \delta_{i,g}^e PE_{i,,g,t}^{\frac{\sigma_y - 1}{\sigma_y}} \right) \right]^{\frac{1}{\sigma_y - 1}} - \theta_j^v PY_{j,,g,t}^v - \theta_j^d \sum_i a_{i,j}^d P_{i,g,t} \quad (3)$$

where:  $\Pi_{j,g,t}^y$  is the unit profit of activity in sector  $j$ ;  $PE_{j,g,t}$  is the export price of good  $j$   $PD_{j,g,t}$  is the domestic price of good  $j$ ;  $PY_{j,g,t}^v$  is the price of value added per unit of output in activity  $j$ ;  $\sigma_y$  is a transformation elasticity parameter ;  $P_{i,g,t}$  is the price of final goods used as intermediate goods;  $\delta_{j,g}^e$  is the share parameter for exports in total production;  $\theta_{j,g}^v$  is the share of costs paid to labour and capital;  $\theta_{j,g}^d$  is the cost share of domestic intermediate inputs;  $a_{i,j}^d$  are input-output coefficients for domestic supply of intermediate goods.

### Trade arrangements

Economies are open for interstate and national trade. Exports and imports are guided by the ratio of domestic to foreign prices and balanced over years. Trade takes place between these 38 provinces and the ROW and given by the standard Armington functions.

$$A_{i,g,t} = \Phi \left( \delta_{i,g}^d D_{i,g,t}^{\frac{\sigma_m-1}{\sigma_m}} + \delta_{i,g}^m M_{i,g,t}^{\frac{\sigma_m-1}{\sigma_m}} \right)^{\frac{\sigma_m}{\sigma_m-1}} \quad (4)$$

where  $A_{i,g,t}$  is the Armington CES aggregate of domestic supplies  $D_{i,g,t}$  and import supplies  $M_{i,g,t}$  for each sector,  $\delta_{i,g}^d$  is the share of domestically produced goods,  $\delta_{i,g}^m$  is the share of good  $i$  imports,  $\sigma_m$  is the elasticity of substitution in the aggregate supply function, and  $\Phi$  is the shift parameter of the aggregate supply function.

The value of exports balances to the value of imports over the model horizon but it is possible to have imbalances on trade in the short run:

$$\sum_g PE_{i,g,t} E_{i,g,t} = \sum_g PM_{i,g,t} M_{i,g,t} \quad (5)$$

Households pay taxes to their governments and governments return part revenue as transfers to the poor households. They use rest of it to provide public services, education, health, security, law and order. Public goods by the central and state governments are:

$$G_{i,t} = \sum_{i=1}^N g_{i,g,t}; GS_{i,t} = \sum_{i=1}^N gS_{i,g,t} \quad (6)$$

Central and state revenues from direct and indirect taxes as:

$$RV_{i,t} = \sum_{h=1}^H t_w^h w_{i,t} LS_t^{i,h} + \sum_{h=1}^H t_k^i r_t K_{i,,g,t} + \sum_{h=1}^H t_{i,t}^h p_{i,t} C_{i,g,t}^h \quad (7)$$

$$RVS_{i,t} = \sum_{h=1}^H t_w^h w_{i,t} LS_t^{i,h} + \sum_{h=1}^H t_k^i r_t K_{i,,g,t} + \sum_{h=1}^H t_{s,t}^h p_{i,t} C_{i,g,t}^h \quad (7s)$$

Revenue of the central and state governments are balanced over the model horizon:

$$\sum_{t=1}^{\infty} G_{i,t} + \sum_{h=1}^H R_t^{i,h} + TR_t^i = \sum_t (RV_{i,t}) \quad (8)$$



$$\sum_{t=1}^{\infty} GS_{i,t} + \sum_{h=1}^H RS_t^{i,h} = \sum_t^{\infty} (RVS_{i,t}) + TR_t^i \quad (8s)$$

Optimal level of public sector balances benefits and costs from the public sector activities at both central and state levels.

### Drivers of the Dynamic in the Economy

Dynamics of the economy are driven by the accumulation of capital and fluctuations in labour supply because of fluctuations in the supply of labour. Capital stock evolves naturally with its initial and boundary conditions:

$$K_{i,g,t} = (1 - \delta_{i,g})K_{i,g,t-1} + I_{i,g,t}; K_{i,g,t} = K_{i,g,0} \quad K_{i,g,T} = (g_{i,g} + \delta_{i,g})K_{i,g,T-1} \quad (9)$$

Similarly the labour supply equations for each household with some transition probability between employment and unemployment

$$LS_t^{i,h} + L_t^{i,h} = \bar{L}_t^{i,h}; \bar{L}_t^{i,h} = \bar{L}_0 e^{n_{i,t}} \quad (10)$$

In aggregate the link between employment, unemployment and the total labour force of the economy

takes the following form:  $E_{i,t} + UN_{i,t} = \sum_{h=1}^H \bar{L}_t^{i,h}$

where  $E_{i,t}$  denotes the number of total employed,  $UN_{i,t}$  number of unemployed out of total labour force

$\sum_{h=1}^H \bar{L}_t^{i,h}$ . Both of these return to the steady state path in the long run.

The major feature of an inter-temporal competitive general equilibrium model is that demand equals supply in equilibrium in all periods in labour, capital, and goods markets. Trade and government budget is balanced over time. Equilibrium is guaranteed by the relative prices that guarantee that demand equals supply in each market. These prices in turn are determined in terms

of behavioral parameters such as shares of spending, costs and the elasticities of substitution in preferences (inter and intra temporal), technology (nested production function) trade (differentiated product assumption) accumulation as given in Table 2. Other parameters that determine relative prices include depreciation and discount rates, fiscal policy parameters such as tax rates on capital income, labour income and final demand as well as endowments initial and terminal capital and labour (see Appendix A).

A competitive dynamic general equilibrium is given by the set prices of composite commodities,  $P_{i,t}$ ; prices of domestic goods sold in domestic markets,  $PD_{i,t}$ ; prices of exported commodities,  $PX_{i,t}$ ; prices of capital goods,  $P_{j,t}^k$ ; prices of terminal capital,  $PTK_{j,t}$ ; wage rates for each categories of labor,  $W_{h,t}$ ; prices of government services,  $PG_t$ ; prices of provisions for tourism,  $PT_t$ ; prices of transfer,  $PR_t$ ; prices of consumption,  $PU_t$ ; price of aggregate welfare,  $PW_t$ ; price of foreign exchange,  $PFX_t$ ; present value of foreign exchange,  $PVPFX_t$ ; rental rate of capital for each sector,  $r_1^k: \mathbb{R}_+ \rightarrow \mathbb{R}$ , and sequence of gross output,  $Y_{i,t}$ ; total supply of commodities,  $A_{i,t}$ ; sectoral capital stock,  $K_{i,t}$ ; sectoral investment,  $I_{i,t}$ ; exports,  $X_{i,t}$ ; government services,  $GOV_t$ ; level of household utility from consumption,  $U_t$ ; and total welfare,  $w$  such that given these prices and commodities such that

- households solve intertemporal utility maximization problems;
- investors solve intertemporal profit maximization problem;
- markets for goods and services, labor, capital clear;
- government constraint is satisfied;
- and balance of payments condition is fulfilled.

Theoretically existence, uniqueness and stability of general equilibrium is guaranteed by second differentiability of the non-linear demand and supply functions emerging from the constrained

dynamic optimization (Debreu (1959)). Practically this model is solved using mixed complimentary algorithm in Path solve in GAMS/MPSGE (Rutherford (1995), and Dixon and Parmenter (1996)).

## Benchmarking Procedure

Dynamics of this model are driven by growth of capital and labour. Labour growth rates are assumed exogenous. Share parameters in consumption and production are calibrated using the benchmark quantities. Inter and intra temporal elasticities of substitution in consumption and among skill categories labour and between labour and capital in production. Calibration of capital accumulation process is crucial in solving the model.

There are essentially five steps involved in calibration of this dynamic model. The first step relates to forming a relation between the price of investment good at period  $t$  in country  $i$ ,  $P_{i,t}$  and the price of capital in period  $t+1$ ,  $P_{i,t+1}^k$ . It also needs specifying a link between prices of capital stock at periods  $t$  and  $t+1$ ,  $P_{i,t}^k$  and  $P_{i,t+1}^k$ , with due account of the rental on capital and the depreciation rate. For instance, one unit of investment made using one unit of output in period  $t$  produces one unit of capital stock in period  $t+1$ . This implies,  $P_{i,t} = P_{i,t+1}^k$ , where  $P_{i,t}$  is the price of one output in period  $t$  and  $P_{i,t+1}^k$  is the  $t$  period price of one unit of capital in period  $t+1$ .

Capital depreciates at the rate of  $\delta_i$ . One unit of capital at the beginning of period  $t$  earns a rental  $R_{i,t}^t$  and delivers  $(1 - \delta_i)$  units of capital at the end of period  $t$  (or at the start of the  $t+1$  period),  $(1 - \delta_i)P_{i,t+1}^k$ . Here  $R_{i,t}^t$  is also measured in term of  $P_{i,t+1}^k$  or  $P_{i,t}$ . We therefore must have:

$$P_{i,t}^k = R_{i,t}^t + (1 - \delta_i)P_{i,t+1}^k \quad (11)$$

In a perfect foresight world price of capital in period  $t$  really reflects the sum of discounted rental over time.

The second step of calibration involves setting up a link of the rental rate with the benchmark interest rate and the depreciation. The rental covers depreciation and interest payment for each unit of investment. When rental is paid at the end of the period

$$R_{i,t}^t = (r_i + \delta_i)P_{i,t}^k = (r_i + \delta_i)P_{i,t+1}^k \quad (12)$$

where  $r$  is the benchmark real rate of interest.

Thirdly step of calibration involves forming relation between the future and the current price of capital. Use equation (6) and (7) together to get

$$\frac{P_{i,t+1}^k}{P_{i,t}^k} = \frac{1}{1 + r_i} \approx 1 - \delta_i \quad (13)$$

This means that the ratio of prices of the capital at period  $t$  and  $t+1$  equals to the market discount factor in the model, which is  $(1 - \delta)$ .

The fourth step of calibration involves setting up equilibrium relation between capital earning (value added from capital) and the cost of capital. We compute values for sectoral capital stocks from sectoral capital earnings in the base year. If capital income in country  $i$  sector  $g$  in the base year is  $\bar{V}_{i,g}$ , we can write  $\bar{V}_{i,g} = R_{i,g} K_{i,g}$ . Thus investment per sector is tied to earnings per

sector. Since the return to capital must be sufficient to cover interest and depreciation, we can also write

$$\bar{V}_{i,g} = (r_i + \delta_i)P_{i,t+1}^k K_{i,g}, \text{ or } K_{i,g} = \frac{\bar{V}_{i,g}}{(r_i + \delta_i)} \quad \text{Since } P_{i,t} = P_{i,t+1}^k = 1 \quad (14)$$

The fifth step of calibration involves setting up relation between the investment and capital earning on the balanced growth path. Investment should be enough to provide for growth and depreciation,  $I_{i,g} = (g_i + \delta_i)K_{i,g}$ , which together with (9) implies

$$I_{i,g} = \frac{(g_i + \delta_i)}{(r_i + \delta_i)} \bar{V}_{i,g} \quad (15)$$

The balance between investment and earnings from capital is restored here by adjustment in the growth rate  $g_i$  that responds to changes in the marginal productivity of capital associated to change in investment. Readjustment of capital stock and investment continues until this growth rate and the benchmark interest rates become equal.

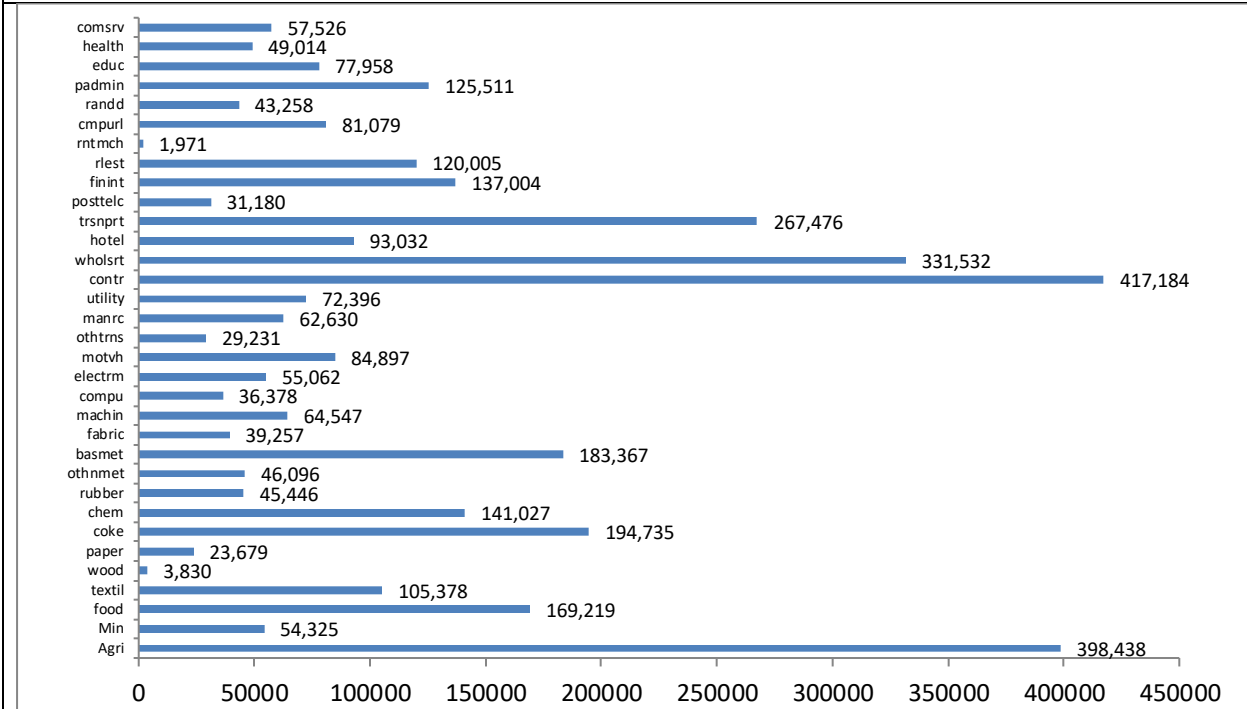
If the growth rate in sector  $g$  is larger than the benchmark interest rate then more investment will be drawn to that sector leading to an increase in the capital stock in that sector. By the process of diminishing return to capital more investment eventually will lower growth rate of that sector eliminating the excess returns that attracted investment in the beginning. In the benchmark equilibrium, all reference quantities grow at the rate of labour force growth,  $g$ , and reference prices are discounted on the basis of the benchmark rate of return as given by equation (8) above.

## V. Input-output table of India for benchmarking the steady state

This dynamic CGE model is calibrated to the 33 sector input output table of India constructed from the OECD's input-output database (see IO table in the appendix). As shown in Figure 14 construction, agriculture, wholesale and transport sectors are the largest ones. Food, base material, coke, chemical financial intermediation, real estate and public administration are middle size sectors. Health, education, paper, wood, computing are still very small sectors. Sector wise analysis like this is very important in order to figure out extensive backward and forward linkages in the economy. Then model is augmented to include ten categories of households in order to study the patterns of income distribution in the benchmark economy and to assess impacts on this from various policy reform scenarios. Main elements of this dataset and parameters are explained in this section.

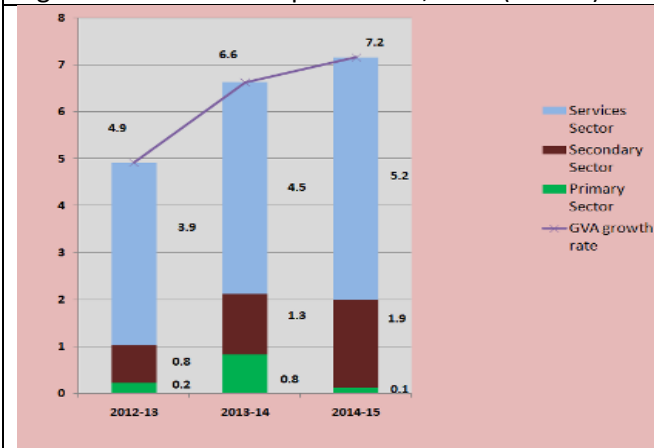
Construction is the largest sector in India in recent years (Figure 14). Infrastructure projects such as roads, railways, ships, communications, emerging large smart cities and upgrade in houses, schools, hospitals or public and community buildings explain massive size of this sector. The second largest sector is the agriculture sector that provides employment to millions of farmers, as 60-70 % of population in India is still linked directly or indirectly to the agriculture sector.

**Figure 14: Sectoral Composition of Gross Output in India, \$Billion**

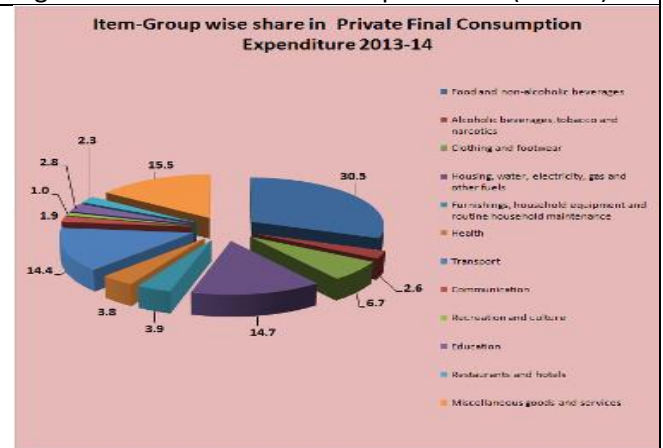


Source: 2011 Input-Output Table of India, OECD 2016. <https://stats.oecd.org/index.aspx?DatasetCode=IOTS>

**Figure 15: Structure of production, 2017 (MOSPI)**



**Figure 12: Structure of consumption 2017(MOSPI)**



Source: <http://mospi.nic.in/>

The data in the input output table is used to calibrate the key parameters of the model. Some key elasticity parameters as listed in Table 2 are based on the literature. The *intertemporal elasticity of substitution* ( $\sigma_{Lu}$ ) measures the responsiveness of the composition of a household's current and future demand for the composite consumption good to relative changes in the rate

of interest, and is a crucial determinant of household savings (see Bhattarai et al. 2017, Haughton et al. (2017) for detailed discussion on elasticities). The *intra-temporal elasticity of substitution between consumption and leisure* ( $\sigma_u$ ) determines how consumers' labor supply responds to changes in real wages. Further discussion on how to derive numerical values of substitution elasticities from labor supply elasticities is provided in earlier studies on tax incidence analysis (Bhattarai and Whalley 1999). The *intra-temporal elasticity of substitution among consumption goods* ( $\sigma_C$ ) captures the degree of substitutability among goods and services in private final consumption. A higher value implies more variation in consumption choices when the relative prices of goods and services change.

The *Armington elasticity of transformation* ( $\sigma_e$ ) determines the sale of domestically-produced goods between the home and foreign markets in response to relative prices between these two markets. The *Armington substitution elasticity* ( $\sigma_m$ ) determines how the domestic and import prices affect the composition of demand for home and foreign goods. Higher values of these elasticities mean a greater impact of the foreign exchange rate in domestic markets. Early estimates of the *elasticity of substitution between capital and labor* ( $\sigma_v$ ) may be found in Arrow, Chenery, Minhas, and Solow (1961).



Steady state growth rate for sectors ( $g$ )	0.075
Net interest rate in non-distorted economy ( $r$ or $\rho$ )	0.05
Sector specific depreciation rates ( $\delta_i$ )	0.05
Elasticity of substitution in domestic returns and capital flows, $\sigma_k$	1.4
Elasticity of substitution for composite investment, $\sigma$	1.3
Elasticity of transformation between Indian domestic supplies and exports to Rest of the World (ROW), $\sigma_\varepsilon$ (can be sector-specific)	2.0
Elasticity of substitution between India's domestic products and imports from Rest of the World (ROW), $\sigma_m$	1.5
Inter-temporal elasticity of substitution, $\sigma_{LU}$	0.99
Intra-temporal elasticity of substitution between leisure and composite goods	1.95
Elasticity of substitution in consumption goods across sectors, $\sigma_c$	2.15
Elasticity of substitution between capital and labor, $\sigma_v$	2.5
Reference quantity index of output, capital and labor for each sector, $Q_{if}$	$(1 + g)^{Y-1}$
Reference index of price of output, capital and labor for each sector, $P_{if}$	$1/(1 + r)^{Y-1}$

Source: based on author's literature review.

Table 3: Share parameters for consumption wage and interest rate

	hit	CNSHR	WAGESHR	INTSHR
h1	0.1	0.002	0.002	0.002
h2	0.1	0.004	0.004	0.004
h3	0.1	0.008	0.008	0.008
h4	0.1	0.013	0.013	0.013
h5	0.1	0.018	0.018	0.018
h6	0.1	0.027	0.027	0.027
h7	0.1	0.038	0.038	0.038
h8	0.1	0.057	0.057	0.057
h9	0.1	0.095	0.095	0.095
h10	0.1	0.738	0.738	0.738

Source: computed from the Input-Output Table of India, OECD 2016.

Table 4: Baseyear factor endowments, production taxes and depreciation						
	capital	labour	kstock	ktax	labtax	deprec
Agri	22913	293516	229132	-0.517	-0.014	0.05
Min	11807	30838	118069	0.064	0.008	0.05
food	2600	18001	26004	0.197	0.010	0.05
textil	1922	18227	19224	0.286	0.010	0.05
wood	79	589	791	0.322	0.014	0.05
paper	639	4557	6393	1.299	0.061	0.05
coke	2397	24490	23971	2.685	0.088	0.05
chem	4083	32538	40827	1.215	0.051	0.05
rubber	905	8429	9047	2.049	0.073	0.05
othmet	3564	13736	35641	0.519	0.045	0.05
basmet	4041	33223	40412	1.701	0.069	0.05
fabric	1089	8770	10889	1.335	0.055	0.05
machin	1850	14685	18498	1.979	0.083	0.05
compu	509	6722	5086	4.625	0.117	0.05
electrm	1045	9160	10450	3.444	0.131	0.05
motvh	1343	13836	13426	3.351	0.108	0.05
othtrns	791	6072	7914	1.433	0.062	0.05
manrc	403	4808	4035	1.296	0.036	0.05
utility	4037	31928	40368	-0.694	-0.029	0.05
contr	40379	106149	403791	0.258	0.033	0.05
wholsrt	57143	231166	571430	0.024	0.002	0.05
hotel	2329	23078	23287	0.248	0.008	0.05
trsnprt	34532	83363	345318	0.376	0.052	0.05
posttelc	3709	14361	37088	-0.015	-0.001	0.05
finint	29824	75705	298244	0.024	0.003	0.05
rlest	39545	73243	395453	0.003	0.001	0.05
rntmch	471	1116	4706	0.007	0.001	0.05
cmpurl	36390	23331	363902	0.011	0.006	0.05
randd	3022	21463	30223	0.170	0.008	0.05
padmin	16992	97005	169924	0.050		
educ	4736	65060	47356	0.029	0.001	0.05
health	3817	25834	38166	0.267	0.013	0.05
comsrv	4256	38449	42561	0.130	0.005	0.05

Source: computed from the Input-Output Table of India, OECD 2016.

Given the dynamic CGE model and parameter sets as explained in this section, this model is used to compute the benchmark reference path of India in multi-sectoral and multi-household settings. This provides the evolution of Indian economy for next 25 years. The next step we take is to compute scenarios of tax policy reforms. We consider the following sets of tax policy reforms. GST replaces all excise and production taxes, a 12 percent GST is applied to all sectors of the economy and households ultimately pay these taxes. All households are subject to pay 5 percent household income tax. These counterfactual structures are close to the Modi government initiative for minimum government and maximum governance. Results of the model

based on solutions of the model for the benchmark and counter factual scenarios are analyzed in greater details in the next section.

## VI. Analysis of Model results

The dynamic CGE model, with 25,839 variables was solved to assess macroeconomic, sectoral and household level impacts of GST reforms. Benchmark reproduced the steady state scenario of the Indian economy from 2017 to 2042 leaving the economy grow at the steady state afterwards. Key parameters of the model were given in the last section and some sensitivity analyses to those key parameters were conducted to determine the robustness of these results. This section compares the GST reform scenario to the benchmark economy.

Impacts of GST reforms are very positive for growth, capital formation, investment, consumption and employment in the Indian economy. Real GDP will be 5.4 to 7.5 percent higher relative to the benchmark economy. This is possible as this reform assures investors and the aggregate investment rises by up to 9.5 after the GST reform relative to the benchmark. Smooth flow of goods and services also reduces the rate of depreciation of capital, it raises inflows of FDI, which combined with additional net investment raises the stock of capital up to 35 percent towards the end of model horizon.

Year	2017	2018	2019	2020	2021	2027	2032	2037	2042
Period	1	2	3	4	5	10	15	20	25
Real GDP	5.4	5.8	6.0	6.2	6.4	7.0	7.2	7.4	7.5
Investment	9.5	8.8	8.5	8.5	8.4	8.4	8.5	8.6	8.9
Capital stock	23.8	25.3	26.4	27.4	28.3	32.0	33.6	34.5	35.2
Employment	1.1	1.1	1.1	1.0	1.0	0.8	0.8	0.8	0.8
Consumption	4.1	4.8	5.2	5.4	5.6	6.4	6.7	6.8	6.9

Source: Dynamic CGE model of India of this paper

Higher growth rate allows more consumption which is higher than 6.3 percent relative to the benchmark.

In general the GST thus raises capital intensity of the Indian economy. Impact on employment is positive but GST reforms raises employment only up to 1 percent above the benchmark. This is partly due to substitution of labour by capital. Creating more employment requires expansion of labour intensive service sectors along with investment in human capital.

<b>Table 2. Summary of Relative Effects of the tax reforms on welfare Groups</b>						
<b>Year</b>	<b>2017</b>	<b>2022</b>	<b>2027</b>	<b>2032</b>	<b>2037</b>	<b>2042</b>
<b>Period</b>	<b>1</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>20</b>	<b>25</b>
	% change in wellbeing ("utility")					
Decile1	5.40	6.50	6.95	7.21	7.36	7.48
Decile2	-45.89	-45.62	-45.56	-45.52	-45.50	-45.48
Decile3	5.70	6.73	7.12	7.32	7.41	7.44
Decile4	6.35	7.38	7.77	7.97	8.06	8.09
Decile5	6.48	7.51	7.90	8.11	8.20	8.23
Decile6	4.18	5.19	5.57	5.77	5.87	5.89
Decile7	5.29	6.31	6.69	6.89	6.98	7.01
Decile8	5.04	6.06	6.45	6.65	6.74	6.77
Decile9	5.62	6.65	7.03	7.23	7.33	7.36
Decile10	6.96	7.99	8.38	8.58	8.68	8.71
	% change in labor supply					
Decile1	5.26	6.28	6.66	6.86	6.96	6.98
Decile2	6.02	7.05	7.43	7.63	7.73	7.76
Decile3	1.28	1.13	1.01	0.96	0.94	0.95
Decile4	0.80	0.65	0.53	0.48	0.46	0.47
Decile5	0.69	0.55	0.43	0.37	0.36	0.37
Decile6	2.42	2.27	2.15	2.09	2.07	2.08
Decile7	1.59	1.45	1.33	1.27	1.25	1.26
Decile8	1.77	1.63	1.51	1.45	1.43	1.44
Decile9	1.34	1.19	1.07	1.02	1.00	1.01
Decile10	0.34	0.20	0.08	0.02	0.00	0.01
	% change in net consumption					
Decile1	0.04	-0.53	-0.78	-0.91	-0.96	-0.97
Decile2	0.04	-0.53	-0.78	-0.91	-0.96	-0.97
Decile3	3.49	5.04	5.57	5.85	5.98	6.04
Decile4	4.12	5.68	6.21	6.49	6.63	6.68
Decile5	4.25	5.81	6.34	6.62	6.76	6.82
Decile6	2.00	3.53	4.05	4.32	4.46	4.52
Decile7	3.08	4.62	5.15	5.43	5.56	5.62
Decile8	2.85	4.38	4.91	5.18	5.32	5.38
Decile9	3.41	4.96	5.49	5.76	5.90	5.96
Decile10	4.72	6.28	6.82	7.10	7.24	7.29

Source: Dynamic CGE model of India of this paper

The distribution income also becomes more equal after the GST reforms. The economic wellbeing of households and their consumption increases up to by 8 percent above the benchmark as shown in the upper section of Table 2. They also increase labour supply to take up jobs created additionally.

Year	2017	2022	2027	2032	2037	2042
Period	1	5	10	15	20	25
<b>Industry</b>						
Agriculture, hunting, forestry and fishing	-0.6	-0.2	0.1	0.2	0.3	0.3
Mining and quarrying	-1.2	-0.9	-0.6	-0.3	-0.2	-0.1
Food products, beverages and tobacco	5.5	6.4	6.8	7.0	7.1	7.2
Textiles, textile products, leather and footwear	8.9	10.1	10.5	10.8	10.9	11.0
Wood and products of wood and cork	-3.5	-3.2	-2.9	-2.8	-2.7	-2.7
Pulp, paper, paper products, printing and publishing	13.5	14.9	15.3	15.6	15.7	15.9
Coke, refined petroleum products and nuclear fuel	8.6	9.8	10.2	10.4	10.6	10.7
Chemicals and chemical products	9.9	10.9	11.3	11.5	11.6	11.7
Rubber and plastics products	4.8	6.0	6.3	6.5	6.6	6.6
Other non-metallic mineral products	-14.7	-16.4	-16.4	-16.3	-16.3	-16.2
Basic metals	-10.2	-10.4	-10.3	-10.3	-10.2	-10.2
Fabricated metal products	-8.7	-8.7	-8.6	-8.5	-8.4	-8.4
Machinery and equipment, nec	-6.1	-5.3	-5.2	-5.1	-5.1	-5.0
Computer, Electronic and optical equipment	0.8	1.9	2.1	2.2	2.3	2.4
Electrical machinery and apparatus, nec	-8.5	-7.8	-7.7	-7.6	-7.6	-7.5
Motor vehicles, trailers and semi-trailers	-4.9	-3.9	-3.8	-3.7	-3.6	-3.6
Other transport equipment	-3.3	-2.5	-2.3	-2.2	-2.1	-2.0
Manufacturing nec; recycling	0.0	1.0	1.3	1.5	1.6	1.7
Electricity, gas and water supply	-0.9	-0.4	-0.1	0.0	0.2	0.3
Construction	-23.3	-25.0	-24.9	-24.9	-24.9	-24.8
Wholesale and retail trade; repairs	0.4	0.9	1.2	1.4	1.5	1.7
Hotels and restaurants	8.7	10.2	10.7	10.9	11.1	11.2
Transport and storage	13.6	16.4	17.0	17.3	17.5	17.7
Post and telecommunications	6.7	8.1	8.5	8.8	8.9	9.1
Financial intermediation	2.6	3.7	4.1	4.4	4.6	4.7
Real estate activities	5.4	10.1	11.1	11.7	12.1	12.3
Renting of machinery and equipment	2.4	4.4	5.0	5.3	5.5	5.7
Computer and related activities	-2.0	-2.5	-1.6	-1.0	-0.6	-0.2
R and D and other business activities	-1.8	-1.4	-1.1	-1.0	-0.8	-0.7
Public administration and defence; compulsory social s	7.1	8.7	9.1	9.4	9.5	9.6
Education	8.4	9.2	9.5	9.7	9.7	9.8
Health and social work	18.0	20.5	21.1	21.4	21.5	21.6
Other community, social and personal services	8.5	9.7	10.1	10.3	10.4	10.5

Source: Dynamic CGE model of India of this paper

Increase in GDP is possible as output of the most of 33 production sectors increase after the implementation of GST as shows in Table 3. Food and textile, paper, printing and publishing, education and health, real estate, transport and storage sectors experience up to 21 percent expansion above the benchmark economy after the GST reforms. Resources move from less productive to more productive sectors as output of construction, non-metallic minerals and wood products decline after the GST.

Year	2017	2022	2027	2032	2037	2042
Period	1	5	10	15	20	25
<b>Industry</b>						
Agriculture, hunting, forestry and fishing	23.8	28.6	31.9	33.8	34.9	35.5
Mining and quarrying	23.8	26.9	29.6	31.1	32.0	32.6
Food products, beverages and tobacco	23.8	36.0	39.4	41.3	42.3	42.9
Textiles, textile products, leather and footwear	23.8	39.8	43.4	45.4	46.5	47.3
Wood and products of wood and cork	23.8	24.7	27.6	29.3	30.2	30.8
Pulp, paper, paper products, printing and publishing	23.8	47.3	50.7	52.6	53.7	54.4
Coke, refined petroleum products and nuclear fuel	23.8	40.4	43.5	45.3	46.3	47.0
Chemicals and chemical products	23.8	41.8	45.1	46.9	48.0	48.6
Rubber and plastics products	23.8	36.6	39.6	41.3	42.3	42.9
Other non-metallic mineral products	23.8	8.1	10.2	11.3	12.0	12.5
Basic metals	23.8	16.6	19.0	20.3	21.1	21.6
Fabricated metal products	23.8	19.5	22.0	23.4	24.2	24.8
Machinery and equipment, nec	23.8	24.1	26.6	28.0	28.8	29.3
Computer, Electronic and optical equipment	23.8	33.4	36.2	37.7	38.6	39.2
Electrical machinery and apparatus, nec	23.8	21.1	23.4	24.7	25.4	25.9
Motor vehicles, trailers and semi-trailers	23.8	25.3	27.8	29.2	30.0	30.5
Other transport equipment	23.8	28.8	31.6	33.2	34.1	34.7
Manufacturing nec; recycling	23.8	31.3	34.5	36.3	37.4	38.0
Electricity, gas and water supply	23.8	28.2	31.7	33.6	34.7	35.4
Construction	23.8	-3.7	-2.1	-1.1	-0.6	-0.2
Wholesale and retail trade; repairs	23.8	29.1	32.0	33.7	34.7	35.3
Hotels and restaurants	23.8	42.1	45.8	47.8	49.0	49.7
Transport and storage	23.8	47.3	50.3	52.0	53.0	53.7
Post and telecommunications	23.8	37.2	40.5	42.3	43.4	44.1
Financial intermediation	23.8	32.6	35.5	37.2	38.1	38.8
Real estate activities	23.8	40.7	44.2	46.2	47.4	48.2
Renting of machinery and equipment	23.8	33.4	36.5	38.2	39.2	39.9
Computer and related activities	23.8	23.7	26.0	27.3	28.2	28.8
R and D and other business activities	23.8	28.0	31.1	32.9	33.9	34.6
Public administration and defence; compulsory social s	23.8	39.8	43.3	45.2	46.3	47.0
Education	23.8	40.9	44.5	46.5	47.6	48.3
Health and social work	23.8	55.1	59.0	61.2	62.5	63.2
Other community, social and personal services	23.8	37.0	40.4	42.4	43.5	44.2

Source: Dynamic CGE model of India of this paper

In general, by liberalizing the economy, the GST reforms make a very positive atmosphere for investment (Table 7) and capital accumulation (Table 4). Capital stock expands up to 60 percent above the benchmark economy because of expansion in investment and more efficiency in the use of capital that reduces the cost of capital. Rapid expansion in production creates this supply side response, GST reform plays a vital role in this direction.

Year	2017	2022	2027	2032	2037	2042
Period	1	5	10	15	20	25
<b>Industry</b>						
Agriculture, hunting, forestry and fishing	-0.60	-1.33	-1.64	-1.80	-1.88	-1.90
Mining and quarrying	-9.16	-10.13	-10.59	-10.84	-10.96	-11.01
Food products, beverages and tobacco	-3.68	-4.60	-4.97	-5.17	-5.26	-5.29
Textiles, textile products, leather and footwear	-5.50	-6.53	-6.93	-7.13	-7.24	-7.28
Wood and products of wood and cork	-7.33	-8.25	-8.64	-8.84	-8.93	-8.97
Pulp, paper, paper products, printing and publishing	-11.73	-12.80	-13.21	-13.43	-13.53	-13.57
Coke, refined petroleum products and nuclear fuel	-11.49	-12.49	-12.91	-13.14	-13.25	-13.29
Chemicals and chemical products	-11.33	-12.39	-12.80	-13.02	-13.12	-13.16
Rubber and plastics products	-13.25	-14.25	-14.65	-14.86	-14.96	-15.00
Other non-metallic mineral products	-13.30	-13.68	-14.11	-14.34	-14.45	-14.49
Basic metals	-13.42	-14.32	-14.75	-14.96	-15.07	-15.12
Fabricated metal products	-14.45	-15.29	-15.71	-15.93	-16.03	-16.08
Machinery and equipment, nec	-15.02	-15.89	-16.32	-16.55	-16.66	-16.70
Computer, Electronic and optical equipment	-13.83	-14.87	-15.30	-15.53	-15.64	-15.69
Electrical machinery and apparatus, nec	-17.76	-18.63	-19.05	-19.27	-19.38	-19.43
Motor vehicles, trailers and semi-trailers	-17.16	-18.02	-18.43	-18.65	-18.76	-18.80
Other transport equipment	-14.82	-15.74	-16.17	-16.39	-16.50	-16.55
Manufacturing nec; recycling	-9.52	-10.63	-11.08	-11.31	-11.43	-11.48
Electricity, gas and water supply	-1.17	-2.03	-2.41	-2.61	-2.71	-2.74
Construction	-13.28	-12.61	-13.06	-13.29	-13.41	-13.46
Wholesale and retail trade; repairs	-5.38	-6.32	-6.75	-6.97	-7.08	-7.12
Hotels and restaurants	9.19	8.03	7.61	7.39	7.29	7.25
Transport and storage	-8.37	-10.21	-10.68	-10.93	-11.05	-11.10
Post and telecommunications	-6.40	-7.61	-8.04	-8.26	-8.37	-8.41
Financial intermediation	-5.89	-7.19	-7.67	-7.93	-8.05	-8.10
Real estate activities	-2.74	-4.87	-5.43	-5.72	-5.87	-5.94
Renting of machinery and equipment	6.62	4.02	3.47	3.19	3.04	2.99
Computer and related activities	-6.47	-7.36	-8.03	-8.38	-8.55	-8.62
R and D and other business activities	-10.07	-11.01	-11.40	-11.61	-11.70	-11.74
Public administration and defence; compulsory social s	-4.04	-5.25	-5.63	-5.83	-5.93	-5.96
Education	-4.15	-5.05	-5.38	-5.54	-5.62	-5.64
Health and social work	-7.41	-8.82	-9.20	-9.40	-9.50	-9.53
Other community, social and personal services	10.26	9.04	8.63	8.41	8.31	8.27

Source: Dynamic CGE model of India of this paper

By eliminating the cascading effects of multiplicity of taxes and by removing the red-tape in the tax administration, GST reduces the cost of supply of goods and services. This results in up to 20 percent reduction in prices of commodities relative to benchmark (Table 5). Consumers are better off as they get commodities at lower prices, producers also gain as the cost of capital decrease. Economy becomes more competitive in the international market. Thus GST reforms is one step to realize the dream of make in



India initiative of the Modi government. It will not only stabilize prices and raise the standard of living in India but also will make India more competitive in the global market.

Year	2017	2022	2027	2032	2037	2042
	1	5	10	15	20	25
<b>Industry</b>						
Agriculture, hunting, forestry and fishing	-0.7	-0.5	-0.4	-0.3	-0.3	38.8
Mining and quarrying	-1.2	-1.8	-2.1	-2.3	-2.4	48.2
Food products, beverages and tobacco	5.7	5.2	5.2	5.2	5.2	39.9
Textiles, textile products, leather and footwear	8.4	8.1	8.3	8.3	8.4	28.8
Wood and products of wood and cork	-3.8	-3.5	-3.6	-3.7	-3.7	34.6
Pulp, paper, paper products, printing and publishing	15.6	13.9	13.8	13.7	13.7	47.0
Coke, refined petroleum products and nuclear fuel	9.4	8.6	8.4	8.3	8.2	48.3
Chemicals and chemical products	10.9	9.7	9.5	9.5	9.4	63.2
Rubber and plastics products	6.1	5.7	5.4	5.3	5.2	44.2
Other non-metallic mineral products	-17.1	-16.4	-16.8	-17.1	-17.2	0.1
Basic metals	-9.8	-9.8	-10.2	-10.4	-10.5	0.4
Fabricated metal products	-7.7	-7.6	-7.9	-8.0	-8.1	0.1
Machinery and equipment, nec	-4.2	-4.0	-4.4	-4.6	-4.7	0.2
Computer, Electronic and optical equipment	4.0	3.2	2.8	2.6	2.5	0.1
Electrical machinery and apparatus, nec	-6.3	-6.3	-6.8	-7.1	-7.2	0.3
Motor vehicles, trailers and semi-trailers	-3.4	-3.1	-3.5	-3.7	-3.9	0.3
Other transport equipment	-0.2	-0.3	-0.6	-0.8	-0.8	0.3
Manufacturing nec; recycling	1.7	1.6	1.6	1.6	1.6	0.2
Electricity, gas and water supply	-1.1	-0.8	-0.6	-0.5	-0.4	0.3
Construction	-31.0	-25.5	-26.1	-26.3	-26.5	0.2
Wholesale and retail trade; repairs	0.2	-0.2	-0.3	-0.4	-0.4	0.2
Hotels and restaurants	10.4	9.9	10.0	10.1	10.2	0.2
Transport and storage	19.3	13.9	13.5	13.3	13.2	0.2
Post and telecommunications	7.3	6.2	6.1	6.0	6.0	0.2
Financial intermediation	3.9	2.6	2.3	2.2	2.2	0.1
Real estate activities	8.9	8.8	8.9	9.0	9.0	0.2
Renting of machinery and equipment	3.9	3.2	3.1	3.0	2.9	0.3
Computer and related activities	-3.8	-4.3	-4.9	-5.1	-5.2	0.3
R and D and other business activities	-1.0	-1.0	-1.0	-1.0	-1.0	0.2
Public administration and defence; compulsory social s	8.5	8.2	8.2	8.2	8.2	0.4
Education	9.1	9.0	9.1	9.1	9.2	0.2
Health and social work	21.0	20.0	20.1	20.1	20.2	0.4
Other community, social and personal services	6.3	5.9	6.0	6.1	6.1	0.4

Source: Dynamic CGE model of India of this paper

Economy creates more employment in the service sectors including the transport and storage, hotel and restaurant, food and beverages and textiles, health and education and community services sectors after

the GST reforms. Some additional measure need to be taken to prevent loss of employment in construction, non-metallic mineral products or fabricated metal products. As stated above increase in capital intensity is the reason for job losses in these sectors. Investment in human capital can correct this.

Year	2017	2022	2027	2032	2037	2042
Period	1	5	10	15	20	25
<b>Industry</b>						
Agriculture, hunting, forestry and fishing	-12.2	20.3	12.0	9.0	8.9	8.9
Mining and quarrying	-18.8	15.6	8.9	6.4	6.4	6.4
Food products, beverages and tobacco	35.5	26.8	18.1	14.9	14.9	14.9
Textiles, textile products, leather and footwear	64.2	31.0	21.8	18.4	18.4	18.3
Wood and products of wood and cork	-34.8	15.3	7.8	5.1	5.0	5.0
Pulp, paper, paper products, printing and publishing	114.0	36.7	27.4	24.0	24.0	24.0
Coke, refined petroleum products and nuclear fuel	70.2	31.0	21.5	18.0	18.0	18.0
Chemicals and chemical products	81.6	31.7	22.7	19.3	19.3	19.3
Rubber and plastics products	44.3	27.6	18.2	14.7	14.7	14.7
Other non-metallic mineral products	-100.0	-44.3	-8.8	-9.9	-9.9	-9.9
Basic metals	-90.2	6.9	0.1	-2.5	-2.5	-2.5
Fabricated metal products	-71.8	10.3	2.9	0.1	0.1	0.1
Machinery and equipment, nec	-43.0	16.4	7.2	3.8	3.8	3.7
Computer, Electronic and optical equipment	25.7	25.2	15.3	11.7	11.7	11.7
Electrical machinery and apparatus, nec	-62.6	13.1	4.2	1.0	1.0	1.0
Motor vehicles, trailers and semi-trailers	-32.9	18.0	8.3	4.7	4.7	4.7
Other transport equipment	-10.2	20.4	11.4	8.1	8.1	8.1
Manufacturing nec; recycling	6.2	23.3	14.2	10.9	10.8	10.8
Electricity, gas and water supply	-17.3	19.6	11.8	8.8	8.8	8.7
Construction	-100.0	-100.0	-41.0	-20.0	-20.0	-20.0
Wholesale and retail trade; repairs	-7.3	19.2	11.5	8.6	8.6	8.5
Hotels and restaurants	#DIV/0!	174.4	23.9	20.4	20.3	20.3
Transport and storage	203.4	34.2	26.2	23.3	23.3	23.3
Post and telecommunications	52.5	27.0	18.7	15.7	15.6	15.6
Financial intermediation	21.1	21.3	14.0	11.3	11.3	11.3
Real estate activities	57.8	30.8	22.2	19.0	18.9	18.9
Renting of machinery and equipment	#DIV/0!	76.0	15.1	12.3	12.3	12.2
Computer and related activities	-47.9	12.2	5.5	3.1	3.1	3.1
R and D and other business activities	-21.3	19.2	11.1	8.1	8.0	8.0
Public administration and defence; compulsory social s	43.0	30.2	21.5	18.2	18.1	18.1
Education	50.4	31.6	22.6	19.3	19.2	19.2
Health and social work	151.8	44.9	34.9	31.3	31.2	31.2
Other community, social and personal services	#DIV/0!	121.5	19.2	15.8	15.8	15.8

Source: Dynamic CGE model of India of this paper

## VII. Conclusions

From analyses based on solutions of a dynamic CGE model of India, it can be said that the goods and service tax (Tax) implemented on 1 July 2017 will enhance growth rates and promote investment and capital accumulation in India. It will improve income, consumption and utility of households no matter whether they belong to poor, middle or rich income groups. It will lower the relative prices of commodities but raise the investment, capital stock and employment among 33 production sectors of the model economy. Government will be able to follow more balanced budget following its strategy of minimal government and maximum governance as revenue increases to finance a reasonable growth in the public spending. This GST reform is of fundamental importance as it will unite all 27 states, 7 union territories by integrating more than seven indirect taxes at the central level, seven another taxes at the state level and eliminating more than 500 special cases of indirect taxes making one tax, one nation and one market idea possible for India.

The dynamic CGE model, with 25,839 variables was solved to assess macroeconomic, sectoral and household level impacts of GST reforms. Benchmark reproduced the steady state scenario of the Indian economy from 2017 to 2042 leaving the economy grow at the steady state afterwards. Key parameters of the model were given in the last section and some sensitivity analyses to those key parameters were conducted to determine the robustness of these results. This section compares the GST reform scenario to the benchmark economy. The main results can be enumerated as follows:

- 1) Impacts of GST reforms are very positive for growth, capital formation, investment, consumption and employment in the Indian economy. Real GDP will be 5.4 to 7.5 percent higher with GST reforms relative to the benchmark economy. This is possible as this reform assures investors and the aggregate investment rises by up to 9.5 after the GST reform relative to the benchmark. Smooth flow of goods and services also reduces the rate of depreciation of capital, it raises inflows of FDI, which combined with additional net investment raises the stock of capital up to 35 percent towards the end of model horizon.
- 2) Higher growth rate allows more consumption which is higher than 6.3 percent relative to the benchmark.
- 3) In general the GST thus raises capital intensity of the Indian economy. Impact on employment is positive but GST reforms raises employment only up to 1 percent above the benchmark. This is partly due to substitution of labour by capital. Creating more employment requires expansion of labour intensive service sectors along with investment in human capital.
- 4) The distribution of income also becomes more equal after the GST reforms. The economic wellbeing of households and their consumption increases up to by 8 percent above the benchmark. They also increase labour supply to take up jobs created additionally.
- 5) Increase in GDP is possible as output of the most of 33 production sectors increase after the implementation of GST. Food and textile, paper, printing and publishing, education and health, real estate, transport and storage sectors experience up to 21 percent expansion above the benchmark economy after the GST reforms. Resources move from

less productive to more productive sectors as output of construction, non-metallic minerals and wood products decline after the GST.

- 6) In general, by liberalizing the economy, the GST reforms make a very positive atmosphere for investment and capital accumulation. Capital stock expands up to 60 percent above the benchmark economy because of expansion in investment and more efficiency in the use of capital that reduces the cost of capital. Rapid expansion in production creates this supply side response, GST reform plays a vital role in this direction.
- 7) By eliminating the cascading effects of multiplicity of taxes and by removing the red-tape in the tax administration, GST reduces the cost of supply of goods and services. This results in up to 20 percent reduction in prices of commodities relative to benchmark. Consumers are better off as they get commodities at lower prices, producers also gain as the cost of capital decrease. Economy becomes more competitive in the international market. Thus GST reforms is one step to realize the dream of “make in India” initiative of the Modi government. It will not only stabilize prices and raise the standard of living in India but also will make India more competitive in the global market.
- 8) Economy creates more employment in the service sectors including the transport and storage, hotel and restaurant, food and beverages and textiles, health and education and community services sectors after the GST reforms. Some additional measure need to be taken to prevent loss of employment in construction, non-metallic mineral products or fabricated metal products. As stated above increase in capital intensity is the reason for job losses in these sectors. Investment in human capital can correct this.

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[https://www.youtube.com/watch?v=grz\\_iGHAYS1](https://www.youtube.com/watch?v=grz_iGHAYS1)





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prasad, salt, bindi. Sindoor, stamps, judicial papers, printed books, newspapers, bangles, handloom, Bones and horn cores, bone grist, bone meal, etc.; hoof meal, horn meal, Cereal grains hulled, Palmyra jaggery, Salt - all types, Kajal, Children's' picture, Children's' picture, drawing or colouring books, Human hair Services , Hotels and lodges with tariff below Rs 1,000, Grandfathering service has been exempted under GST,

#### **5%**

##### *Goods*

Items such as fish fillet, Apparel below Rs 1000, packaged food items, footwear below Rs 500, cream, skimmed milk powder, branded paneer, frozen vegetables, coffee, tea, spices, pizza bread, rusk, sabudana, kerosene, coal, medicines, stent, lifeboats, Cashew nut, Cashew nut in shell, Raisin, Ice and snow, Bio gas, Insulin, Agarbatti, Kites, Postage or revenue stamps, stamp-post marks, first-day covers

##### *Services*

Transport services (Railways, air transport), small restaurants will be under the 5% category because their main input is petroleum, which is outside GST ambit.

#### **12%**

##### *Goods*

Apparel above Rs 1000, frozen meat products , butter, cheese, ghee, dry fruits in packaged form, animal fat, sausage, fruit juices, Bhutia, namkeen, Ayurvedic medicines, tooth powder, agarbatti, colouring books, picture books, umbrella, sewing machine, cellphones, Ketchup & Sauces, All diagnostic kits and reagents, Exercise books and note books, Spoons, forks, ladles, skimmers, cake servers, fish knives, tongs, , Spectacles, corrective, Playing cards, chess board, carom board and other board games, like Ludo,

##### *Services*

State-run lotteries, Non-AC hotels, business class air ticket, fertilisers, Work Contracts will fall under 12 per cent GST tax slab

#### **18%**

##### *Goods*

Most items are under this tax slab which include footwear costing more than Rs 500, Trademarks, goodwill, software, Bidi Patta, Biscuits (All categories), flavoured refined sugar, pasta, cornflakes, pastries and cakes, preserved vegetables, jams, sauces, soups, ice cream, instant food mixes, mineral water, tissues, envelopes, tampons, note books, steel products, printed circuits, camera, speakers and monitors, Kajal pencil sticks, Headgear and parts thereof, Aluminium foil, Weighing Machinery [other than electric or electronic weighing machinery], Printers [other than multifunction printers], Electrical Transformer, CCTV, Optical Fiber, Bamboo furniture, Swimming pools and padding pools, Curry paste; mayonnaise and salad dressings; mixed condiments and mixed seasonings

##### *Services*

AC hotels that serve liquor, telecom services, IT services, branded garments and financial services will attract 18 per cent tax under GST, Room tariffs between Rs 2,500 and Rs 7,500, Restaurants inside five-star hotels

#### **28%**

##### *Goods*

Bidis, chewing gum, molasses, chocolate not containing cocoa, waffles and wafers coated with chocolate, pan masala, aerated water, paint, deodorants, shaving creams, after shave, hair shampoo, dye, sunscreen, wallpaper, ceramic tiles, water heater, dishwasher, weighing machine, washing machine, ATM, vending machines, vacuum cleaner, shavers, hair clippers, automobiles, motorcycles, aircraft for personal use.

##### *Services*

Private-run lotteries authorised by the states, hotels with room tariffs above Rs 7,500, 5-star hotels, race club betting, cinema

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A glimpse on the existing tax system is enough for a tentative idea of how GST has changed the indirect tax system in India. Before the GST general sales of goods were liable to VAT and central sales tax (CST) on goods moving across the states. State level VAT ranged from 5 to 15 percent and there were concessional rates of 5 %, 1% and 0 %. According to the KPMG report the main categories of goods covered by these included:

- 1) 5 percent - IT products, intangible goods (such as patents and copyrights), capital goods, chemical fertilizers, cotton, drugs and medicines, iron and steel, industrial inputs, sports goods, tractors
- 2) 1 percent - Gold, silver, precious stones (for example diamonds), articles or ornaments made of the aforementioned
- 3) Zero percent - Books, milk, fresh plants, flowers, vegetables and fruits, meat, fish, prawn, rice, and wheat Zero rated - Exports of goods
- 4) higher VAT rates of 20 percent and above, applicable to petroleum products (such as diesel, petrol, lubricants, and aviation turbine fuel), natural and other gases used as fuel, liquor and beer.
- 5) As regards CST, it is charged at the rate of 2 percent with Form C or VAT rate applicable in the originating state without Form C.
- 6) There is another indirect tax on provision of services known as Service tax, which is ordinarily discharged by the service provider. The standard rate of Service tax was increased vide Union Budget 2015 to 14 percent (effective from 1 June 2015). With effect from 15 November 2015, additional levy of 0.5 percent in the form of Swatch Bharat Cess ('SBC') has been introduced. In effect, the tax levied on services has become 14.5 percent. SBC is not creditable. Further, with effect from 1 June 2016, additional levy of 0.5 percent in the form of Krishi Kalyan Cess ('KKC') has been introduced. In effect, tax levied on services has become 15 percent. KKC can be set off only against output liability of KKC.

In terms of the Service tax law, all services other than those mentioned under the Negative List of services or specifically exempted under any notification, would be liable to Service tax. While any services exported out of India would be zero rated, any services received in India from outside India (import) would be liable to Service tax in the hands of the recipient of such service under reverse charge mechanism. Whether a service would qualify as export/ import would be determined by the Provision of Service Rules, 2012.