WP-2024-002

Policy Alternatives for Accelerating Health & Educational Attainments of Children in India: An Analysis using Computable General Equilibrium Model

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February 2024

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Abstract

Assessing the impact of alternative policy options on developmental goals relating to health and education remains an analytical challenge due to several reasons. Typically, the goals and their associated indicators are non-economic variables that are influenced by a multitude of factors at different levels (household, local, regional and national), and often rooted in different sectors of the economy. Further, these factors interact and influence each other in several ways that are often difficult to capture.

Typically, much of the literature use econometric methods to capture the impact of some micro- or sector specific government policy or programme after controlling for a set of control variables. Often the control variables are at a particular level (such as household demographic, socio-economic, and locational characteristics) and the influence of other factors at different levels (region or macro-level) are captured in a rudimentary manner or ignored completely. While this approach is useful to assess the impact of a single policy, a major shortcoming of this analytical framework is that it does not permit evaluation of policy alternatives and hence cannot provide an assessment of their opportunity costs.

One of the analytical frameworks extensively used in the economics literature to study trade and fiscal policy alternatives is the computable general equilibrium (CGE) model. CGE models inherently account for inter-sectoral and inter-agent linkages and are particularly suited to study policies that have multi-sectoral and/or multi-agent impact. Despite their inherent advantages on these counts, studies using CGE models to assess policy alternatives for achieving developmental targets are very few internationally. This is primarily because the development indicators are mostly non-economic variables whose relationship with other economic variables is not well understood.

In this paper, using India as a case, we demonstrate the use of CGE models to evaluate policy alternatives for achieving specific developmental targets relating to child health and education. We address the question "Which policy option would help India accelerate child health and education status to levels comparable to developed countries in the shortest possible time". We proxy child health by infant mortality rate (IMR) and educational attainment by dropout rates (DOR) at the primary level. We specify a target value for IMR of 10 or less per thousand live births and DOR value less than 1 per cent are more or less, which are comparable with levels prevailing in developed countries.

Towards this, we first develop a recursively dynamic CGE model and augment it by (a) incorporating two simple econometrically estimated equations relating progress in water and sanitation access to public expenditure in these sectors; (b) bringing in the econometric relationship between public expenditure in the education sector and progress in adult education; (c) integrating the econometric relationships to capture the impact of public expenditure on child health and education, taking into account the progress in adult education and access to water and sanitation; and (d) developing a set of link equations to capture the relationship between adult education outcomes and composition of labour supply by education levels.

Through these additional equations, we capture the direct impact of improvements in adult education, water and sanitation on child health and child education and the direct impact of improvements in adult education on the supply of various types of labour force by education levels. The latter allows us to capture the feedback effects of public spending on education on the overall performance of the economy via labour market outcomes, and thus eventually on government fiscal position as well as households' ability to afford health care and education.

Using this augmented recursively dynamic CGE model we simulate the following policy alternatives: (i) economic growth as the driver of progress in child health and education outcomes; (ii) additional public expenditure funded through public borrowings on (a) water and sanitation sector, (b) health sector, (c) education sector and (d) combined water, sanitation, health and education sectors.

The results lead us to suggest that increasing public expenditure on water and sanitation through recourse to public borrowing is the best performing scenario for accelerating child health and education attainment in the country among above mentioned policy alternatives. But, focusing attention on water and sanitation should not be at the cost of government expenditure on education and health.

Keywords: Child Health, Child Education, CGE, SAM, Fiscal Policies, Government Expenditure

JEL Code: C68, H51, H52, I18, I28, E16, E62

Acknowledgements:

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Policy Alternatives for Accelerating Health & Educational Attainments of Children in India: An Analysis using Computable General Equilibrium Model

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1. Introduction

Despite considerable progress in both health and education of children over the last few decades, in terms of SDG index, India ranked 112th among 166 countries in 2023, according to the SDG Index and Dashboards Report 2023. Cross-country comparisons reveal that the country's progress in terms of various child health, child education and overall SDG index lags not just developed counties, but also several developing countries including China and Sri Lanka. It is evident that the country has a long way to go to improve its rank in human development to developed country levels. In particular, the country's progress in child health and education status has been slow. How to accelerate the health and educational attainments of children in India? What are the policy alternatives available to the country? How feasible and sustainable are they? These questions form the subject matter of this study.

Past studies have shown that both child health and education status are influenced by several factors outside of the health and education sectors, and they themselves are interlinked in several ways (Deolalikar, 2005; Sánchez and Sbrana, 2009). Parents' (especially mother's) education (Govindasamy & Ramesh, 1997; Altindag et al., 2011; Bhakta & Ganesh-Kumar, 2014), access to clean water and sanitation (Manga, 1991; Muldoon et al., 2011), and public expenditure on these two sectors (Rani, 2007; Bhalotra, 2007; Farahani et al., 2009; Dreze & Sen, 1995; PROBE Report, 1999; Jayachandran, 2002) apart from social, economic and demographic factors have been identified as important determinants of child health and child education status. In terms of policy prescription, however, most of these studies have laid stress on the inadequate public expenditure on health and education resulting in insufficient provisioning of health care and education facilities as well as trained personnel as the major handicap to improving child health and education attainment, ignoring the cross-sectoral interlinkages that they themselves find.

Ignoring these interlinkages give us only a partial understanding of the factors that hinder India's progress in achieving desirable goals for child health and education. More critically, the policy recommendations coming from such partial / sectoral analysis are also likely to be incomplete at best. Such policy recommendations may not be able to extract the potential synergies inherent in these interlinkages. Consequently, these synergies may remain unexploited thereby slowing down the progress in child health and education attainment.

One plausible reason for this situation is the analytical challenges in assessing the impact of alternative policy options on developmental goals relating to health and education. Here it must be recognised that the health and education related goals and their associated indicators are fundamentally non-economic variables that are influenced by a multitude of factors both economic and non-economic, which are at different levels, viz., household, local, regional and national.

Many of these factors are often rooted in different sectors of the economy and they interact and influence each other in several ways that are often difficult to capture in an analytical model.

Methodologically, much of the literature uses a variety of econometric methods to capture the impact of some micro- or sector specific government policy or programme after controlling for a set of control variables that are different levels. While these econometric models are useful to assess the impact of a single policy, a major shortcoming of this analytical approach is that it often does not permit evaluation of policy alternatives that are rooted across different sectors, and hence cannot provide an assessment of their opportunity costs.

One of the analytical frameworks extensively used in the economics literature to study a variety of economic policy problems is the computable general equilibrium (CGE) model. CGE models inherently account for inter-sectoral and inter-agent linkages and are particularly suited to study policies that have multi-sectoral and/or multi-agent impact. Despite their inherent advantages on these counts, studies using CGE models to assess policy alternatives for achieving developmental targets are very few internationally. This is primarily because the development indicators are mostly non-economic variables whose relationship with other economic variables is not well understood.

Against this background, the main objective of the paper is to examine the scope for pursuing an integrated public policy approach that involves simultaneous investments in health, education, water and sanitation sectors with a view to accelerate the existing rates of improvement in health and educational outcomes for children so that the country reaches levels that are comparable with the developed countries in certain well-defined indicators. Here the health status of children is captured by infant mortality rate (IMR)[2] and educational attainment of children is measured by dropout rates (DOR) at the primary level[3]. An IMR value of 10 or less per thousand live births and DOR value less than 1 per cent, are more or less comparable with levels prevailing in developed countries and hence we specify these values as the target levels in this analysis.

This paper also examines the cost effectiveness of different types of public expenditure policies and the fiscal feasibility / sustainability of enhancing them with a view to accelerate child health and education outcomes to desired levels. Specifically, the objectives of this paper can be stated as follows:

[2] IMR is measured as the number of deaths of children less than one year of age per 1000 live births.

[3] DOR is measured as children withdraw prematurely before completion of primary/elementary level as a percentage of those students who got enrolled in first grade.

i. Which policy option is more suitable to accelerate the progress in improving the health and education indicators of children to levels comparable to those prevailing in developed countries?

ii. Is it cost effective, feasible and sustainable in the long run for India to increase public spending in those sectors in order to achieve desirable goals in child health and education?

Here, cost effectiveness of a particular policy option is assessed in terms of the number of years it takes to achieve the target levels of IMR and DOR. Feasibility / sustainability of a policy option is assessed in terms of its impact on various macroeconomic indicators such as overall growth rate of the economy, private consumption, savings and current account deficit. A policy option that has the least adverse impact on these macroeconomic indicators is considered feasible/sustainable.

Towards addressing the above questions, we use a recursively dynamic computable general equilibrium (CGE) model of the Indian economy that incorporates the various inter-sectoral linkages between child health and education outcomes mentioned above. The analytical framework of CGE models is particularly suited to study the economy-wide impacts of alternative fiscal policies where inter-sectoral and inter-agent linkages play an important role in shaping the final outcomes of variables of interest, such as child health and education as in our context. The CGE model we have used here is based on a Social Accounting Matrix (SAM) for the base period of 2011-12 that we have constructed with a focus on the major social sectors, viz., health, education, water and sanitation.

As will be seen later in detail, our CGE model incorporates the impact of public spending on indicators of (a) child health status, (b) education attainment of both children and adult population, and (c) access to clean drinking water and sanitation. Further, it captures the impact of improvements in adult education, water and sanitation on child health and child education. Besides, the impact of improvements in adult education on the supply of various types of labour force by skill levels is also accounted for here. This helps us to capture the feedback effects of public spending on education on the overall performance of the economy via labour market outcomes, and thus eventually on government fiscal position as well as households' ability to afford health care and education. This latter feature helps us to assess the fiscal feasibility and long-term sustainability of enhanced public expenditure on the social sectors for achieving desirable goals in child health and education attainment.

In the analysis here, we develop alternative scenarios wherein public expenditure in various social sectors is raised. The impacts of the rise in public expenditure on various economic indicators (sectoral output and price, returns to factors of production, household income, consumption and saving, government revenue and fiscal balance, trade flows and the current account, national savings and investment) as well as indicators of focus here, viz., child health (IMR) and education attainment (DOR), along with indicators of adult education attainment (literacy rate, percentage of adults completed higher education and average years of schooling) and access to clean drinking water and sanitation are studied here.

The rest of the paper is organised as follows. The next section gives a brief description of the salient feature of the CGE model. Then alternative policy options along with fiscal strategies to finance these policies are explained in Section 3. The results of these policy simulations are presented in Section 4. Finally, Section 5 discusses the conclusions and the policy recommendations of the analysis.

2. The recursively dynamic CGE model with health, education, water and sanitation

We use a modified version of the static computable general equilibrium (CGE) model of the Indian economy developed by Ganesh-Kumar and Panda (2009). The model by Ganesh-Kumar and Panda (2009) is a static CGE model built around a Social Accounting Matrix (SAM) for the year 2003-04 that distinguishes 71 sectors and 10 household expenditure classes, 5 each in rural and urban areas. We make four major modifications to the CGE model by Ganesh-Kumar and Panda (2009) for this study.

First, we modify the classification in the SAM and update the SAM to the year 2011-12, which is the base year for the SAM/model. The SAM used here distinguishes 9 commodities / sectors, 9 factors of production, and 12 household types distinguished by their location and by the monthly per capita expenditure (MPCE) percentile (Table 1). The sectoral classification is guided by the focus of this study on health and education sectors. Accordingly, these social sectors are clearly separated in the SAM. Further, the SAM also distinguishes Water supply (including sanitation services) as a separate sector given the important role played by these services in influencing both education and health outcomes of children. The other sectors of the economy are included in aggregate terms only in the SAM. The resultant SAM captures the flows in the economy in the base year as per the New Series of the National Accounts Statistics with Base Year 2011-12.

Second, we extend the static CGE model into a recursively dynamic model. The recursive model can be conceived of having two modules: One, a static CGE model, which for any given year solves for the level of output and prices of all commodities, returns to various factors of production, income, expenditure and savings of all households, government revenue, expenditure and savings, commodity exports, imports, the level of foreign flows that satisfies the balance of payments, and the national savings-investment balance. We use the core static CGE model as developed by Ganesh-Kumar and Panda (2009) as such without any change except for updating the various parameter values in accordance with the SAM for 2011-12. While solving the static CGE model, population, factor supplies and factor endowment distribution, government consumption, stocks, the exchange rate and the levels of foreign remittances are treated as exogenous variables whose values for any particular year are kept fixed. The second module, updates these exogenous variables from one year to the next based on various link equations that capture / update (a) the relation between investment in one year and the addition to sectoral capital stock in next year as well as the endowment distribution of capital across various agents, (b) changes in demographic variables and total stock of labour in the economy and across household classes, (c) other macroeconomic parameters such as foreign capital flows, tax rates, government expenditure, etc.

Table 1: Classification in Social Accounting Matrix / CGE model

9 Commodities / activities: Agriculture; Manufacturing-1 (mainly unskilled labour); Manufacturing-2 (mainly skilled labour); Electricity; Water supply; Services-1 (mainly unskilled labour); Education; Medical; Services-2 (mainly skilled labour);
9 Factors consisting of 3 labour types and 6 sectoral capital: Unskilled labour; Semiskilled labour; Skilled labour; Agriculture sector capital; Industries sector capital; Water Supply sector capital; Education sector capital; Medical sector capital; Services sector capital;
12 Household categories: 6 each in rural and urban areas, distinguished by MPCE percentile groups; < 10%; 10% to 30%; 30% to 50%; 50% to 70%; 70% to 90%; > 90%;

Source: Author.

Three, we use the econometric relationships estimated by Bhakta (2014) to capture the impact of public expenditure on child health and education on IMR and DOR. To operationalise this, we use (i) the estimated relationship between public expenditure on water and sanitation and on the extent of household access to safe drinking water and sanitation in own residence reported in the following section; (ii) the endogenously determined level of per capita income in a year as solved by the CGE model. Similarly, the econometric relations estimated in Bhakta (2015) are used to capture the impact of public education on adult and higher education on literacy rate, percentage of population that completed higher education and average years of schooling of young adults in age group 18-45 (males) and 18-40 (females). Here too, we use the endogenously determined level of per capita income in a year as solved by the CGE model and public spending in education sector as per the policy scenario, keeping the other social factors at exogenously fixed levels.

Four, we develop a set of link equations to capture the relationship between adult education outcomes and composition of labour supply by education levels. That is, the composition of labour supply in a year in the model is made conditional on the adult education outcomes in the previous year. Consequently the labour market outcomes in terms of wage rates and usage of different labour types across various sectors in a year itself get linked to progress in adult education. This helps us capture the feedback effects of public spending on education on the overall performance of the economy via the labour market outcomes.

2.1 Core CGE model

The structure of the core static CGE module is similar to the static CGE model developed by Ganesh-Kumar and Panda (2009) and it differs only in terms of the underlying data and parameter values that are derived from the SAM for 2011-12. In this core CGE module, for any given year we solve for the level of output and prices of all commodities, returns to various factors of production, income, expenditure and savings of all households, government revenue, expenditure and savings, commodity exports, imports, the level of foreign flows that satisfies the balance of payments, and the national savings-investment balance.

Domestic production and trade: This core CGE model is built along the approach developed by Dervis, de Melo and Robinson (1982). A distinguishing feature of this approach is that it treats the domestically produced goods and traded goods in a particular sector as imperfect but close substitutes using the Armington specification. The Armington approach helps to avoid complete specialization that is implicit in models with perfectly substitutable commodities. It allows cross hauling wherein simultaneous imports and exports take place in a particular sector as observed in reality. An important consequence of this specification is that domestic market prices do not change by the same order as the change in world price. This imperfect substitutability between domestic and traded goods along with the government's tariffs on imports, export subsidies and indirect taxes / subsidies for domestic goods gives rise to wedge between import price, export price, domestic market price, and producer price in the model. The Armington specification determines commodity-wise imports and exports for a given set of import and export prices in foreign currency units, the exchange rate as determined in the forex market and the set of endogenous domestic market prices that clear the commodity markets.

Sectoral production in the core CGE model is characterised through nested production functions that determine sectoral output and value added, along with profit maximizing levels of demand for various factors of production and intermediate input requirements. The difference between the value of output and value added is the total cost of raw materials and other intermediate goods and services used in the production process. Demand for individual goods and services used as intermediates are based on Leontief type input-output coefficients. Sector-wise optimal demand for various factors of production depends upon both product and factor prices.

Agent behaviour: The agents in the SAM and hence in the model are households, enterprises and government. Households derive their income from their endowment of various factors of production, and also the transfer payments that they receive from the government and from abroad (remittance). After paying direct taxes and setting aside a part of their disposable income as savings, households spend the rest of their budget on various goods and services. Commodity-wise household consumption is given by a Linear Expenditure System (LES) demand system, which is derived from maximizing a Stone-Geary utility function subject to budget constraint.

Government receives its revenue from various taxes (direct taxes, tariffs, domestic indirect taxes), non-tax sources (its endowment of capital), and foreign inflows on government account. The various tax rates are typically fixed exogenously at their base year levels as derived from the SAM. Government expenditure is towards its current consumption, transfers to households, and subsidies for domestic goods and exports. The difference between government revenue and current expenditure is its savings.

Private and public enterprises are the other domestic agents in the model. Their role in the model, however, is fairly rudimentary. They own factors of production (different types of capital) from which they derive income – akin to retained income of firms. While private enterprise pays tax on their retained income and save the rest, public enterprises contribute only to the national savings. This rudimentary characterisation of the role of enterprise is primarily conditioned by the data available in the SAM.

Savings-investment: The core CGE model is a neo-classical savings driven model, wherein the total savings across all agents determines the aggregate investment in the economy. The sources of savings in the economy are the households, enterprises, government and capital flows from the rest of world. The amount of foreign savings in Rupee terms depends upon the volume of foreign capital flows in foreign currency units and the exchange rate. Part of the total savings is invested on fixed capital and the rest on inventory. The inventory requirements are specified for each sector exogenously and this is part of the total demand for each commodity. Given the fixed inventory requirement, it is the total fixed capital formation that ultimately varies with savings. In the core CGE model, for any given year, this total fixed capital investment generates demand for various goods and services.

Markets and their closure: Overall there are three types of markets in the model, viz., for factors, commodities (goods and services) and foreign exchange.

Supply of factors in the model is kept fixed for any given year. Demand for factors arise from the production sectors based on their profit maximising conditions. The default closure for the factor markets is that factor prices adjust to ensure that the aggregate demand for factors across all sectors clear the given supply. The model, however, has the flexibility to allow for unemployment of some / all factors in which case the corresponding factor price(s) is kept fixed; i.e., by introducing factor price rigidity.

In the commodity market, the sources of supply are domestic production and imports, while the sources of domestic demand are intermediates, household, government, inventory and fixed capital formation. For each commodity, domestic market price adjusts to ensure that total supply equals total demand. There is a separate market for exports, wherein export supply is determined by Armington type transformation function, while export demand is determined as a function of exogenously fixed reference world market price and endogenously determined export f.o.b. price. As with all CGE models, these market clearing prices are all relative prices – relative to the overall price index fixed exogenously as the numeraire.

The foreign exchange market in the model reflects the main flows in the balance of payments wherein the difference between the total foreign exchange outgo (towards imports, factor payments and other current transfer to rest of world) and the total foreign exchange inflow (from exports, remittances, factor payments received) is bridged by a matching (inward/outward) capital flow. In the model, all entries in the foreign exchange market are specified in foreign currency units, with the foreign exchange rate being the market clearing price variable. The model allows for two alternative closures for the foreign exchange market: (a) the amount of capital flows in foreign currency units can be kept fixed while allowing the exchange rate to vary to clear the foreign exchange market, or (b) keep the exchange rate fixed and allow the capital flows in foreign currency units to change to clear the foreign exchange market. In a situation where foreign capital is easily available the exchange rate is likely to remain fairly stable even though the exchange rate regime per se is not fixed. As opposed to this, when foreign capital flow is relatively tight the exchange rate is likely to be volatile in order to clear the foreign exchange market. These are indeed alternative characterisation of the foreign exchange market and can be captured through its closure specification.

In this study, with regard to the macroeconomic closure, we specify that (i) there is full employment of all factors of production and hence factor prices adjust to clear the factor markets, (ii) the model is savings driven (neo-classical) implying that total fixed capital formation in the economy depends upon the total savings available from all sources (domestic agents and foreign), and (iii) the foreign exchange rate is fixed and capital flows in foreign currency units adjust to clear the foreign exchange market.

2.2 Health, education, water and sanitation in the CGE model

We extend the CGE model with additional equations for social indicators like child health, child education and adult education outcomes using the econometrically estimated relationships described in Bhakta (2014 & 2015). In doing so, we incorporate their inter-linkages and synergies with other economic variables to prioritise public expenditure towards those activities which have maximum positive impact on these non-economic indicators of social welfare. Besides, we also link the child health outcome to improvements in access to safe drinking water and sanitation facilities at residence as these were found to be critical factors influencing child health. The introduction of these additional equations in the CGE model makes our model unique, particularly in the Indian context. We describe these equations in turn starting from the equations that capture progress in water and sanitation.

Water and sanitation: In order to capture the impact of improvements in access to safe drinking water and sanitation facilities on child health, we first estimate simple linear regression models that relate these two variables to real per capita public expenditure in the water and sanitation sector. We use state-level information on percentage of household with access to safe drinking water and sanitation facilities in own residence from Census of India data for 1991, 2001 and 2011. We specify a double-log form of regression equation with state level fixed effects. Although we have specified a simple regression model, the F-value and the adjusted R-squares show a fairly good fit (Table 2). In both cases public expenditure is found to be a significant driver. The elasticity of per capita expenditure on the access to safe drinking water is 0.264, whereas for sanitation facility the elasticity is 0.63.

Table 2: The estimated models of access to water and sanitation facility

Explanatory Variable	Log(Percentage of households with access to safe drinking water)	Log(Percentage of households with access to sanitation facilities in own residence)
Log(Per capita public expenditure on water and sanitation)	0.264***	0.630***
Intercept	7.490***	11.036***
State Effects	Yes	Yes
No of Observations	80	80
Adjusted R-square	0.79	0.65
F-Value	11.17***	5.87***

Source: Authors' estimates

We specify a slightly modified version of the above econometric equations in the CGE model as given below:

1. $\boldsymbol{water_{it} = e^{\alpha_w + \beta_{w1} logpcrews_{it}}}$
2. $\boldsymbol{sanitation_{it} = e^{\alpha_s + \beta_{s1} logpcrews_{it}}}$

In the above equations (1 and 2), we use the econometrically estimated values of the elasticity of public expenditure for the coefficients (β_{w1} and β_{s1}). The intercept terms in the two equations (α_w and α_s), however, are re-calibrated to adjust for the fact that the CGE model is a national model without any state-level information, whereas the econometric equations involve state-fixed effect terms. Specifically, the intercept terms are recalibrated such that the projected value of water and sanitation from the above equations matches the actual observed levels for the country as a whole in the base year 2011-12. During simulations, public expenditure in this sector is part of the specification of government policy. This allows us to construct scenarios wherein the government increases its expenditure in these sectors.

Child health: We use the econometric relationships estimated by Bhakta (2014) to capture the impact of public expenditure in health sector on IMR. This study used state level information of 20 major states in India. The data contains several socio-economic variables from different sources including District Information System for Education, Sample Registration System, Ministry of Human Resource Development, Census of India, National Sample Survey and Government of India. It applied Simultaneous Equation Model (SEM) to incorporate interlinkages between socio-economic variables and their impact on IMR. The results show one per cent increase in per capita real expenditure on the Supplementary Nutritional Programme ($logpcesnp$) and per capita real GDP ($logpcgdp$) help to reduce IMR by 1.9 and 6.6. Similarly, literacy rate, greater access to safe drinking water ($water$) and sanitation facilities ($sanitation$) may have positive impact on child health status. On the contrary, urbanisation (urb) deteriorated overall child health status in India. Both R-square and Chi-square show the model is a good fit.

We used the above estimated model in the CGE framework with two modifications as shown below:

3. $imrhh_{ht} = \alpha_{imr} + \beta_{imr1}\, logpcgdphh_t + \beta_{imr2}\, logpcesnp_t + \beta_{imr3}\, water_t + \beta_{imr4}\, sanitation_t + \beta_{imr5}\, litrate_t + \beta_{imr6}\, urb_t$

4. $imr_t = \sum_{h=1}^{12} w_h\, imrhh_{ht}$

First, we recalibrate the intercept term (α_{imr}) suitably to adjust for the fixed effects as in the case of water and sanitation described above. Second, instead of directly projecting infant mortality rate at the national level (imr), we project the infant mortality rates at the household-level ($imrhh$) for each household class in the SAM/CGE model using Equation 3 above, and then obtain the national level IMR as a weighted average of the household-level infant mortality rates ($imrhh$) as shown in Equation 4. The household specific weights (w_h) in Equation 4 are the percentage of population in each household class. Since the household classes in SAM/CGE model are defined in terms of percentile values, these weights remain constant over time.

During simulations to project the IMR at the level of individual household classes we use the household specific per capita income ($logpcgdphh$) as solved endogenously in the CGE model instead of using aggregate GDP per capita. The per capita real expenditure on the Supplementary

Nutritional Programme ($logpcesnp$) is part of the government policy specification in the simulation. The level of urbanisation (urb) is specified exogenously using growth rates estimated from the projections of rural and urban population by UN (UN, 2015). The other variables in Equation 3, viz., access to safe drinking water ($water$), access to sanitation facilities ($sanitation$) and literacy rate ($litrate$) are all endogenously determined in the CGE model. The equations determining water and sanitation have been described earlier (Equation 1 and 2), while the determination of literacy rate is elaborated below along with other indicators of adult education outcomes.

Child education: We use the SEM estimated by Bhakta (2014) to incorporate the impact of per capita public expenditure on elementary education ($pcreee$) on child educational outcomes as well. It has incorporated the interlinkages between IMR and DOR as well. The study shows DOR declines by 0.16 per cent with decrease in IMR by one per 1000 live births, and one per cent increase in per child real public spending on elementary education may reduce dropouts in primary level by 1 per cent. Besides, the interlinkages show how increase in public expenditure on SNP will help to improve child education indirectly. Besides, urbanisation improves child educational outcomes by decreasing DOR significantly after controlling state and time fixed effects.

The econometrically estimated relationship suitably recalibrated to adjust for the fixed effects coefficients. The equation we specify in the CGE models is given as,

$$5. \quad dor_t = \alpha_{dor} + \beta_{dor1}\, imr_t + \beta_{dor2}\, pcreee_t + \beta_{dor3}\, urb_t$$

During simulations, $pcreee$ is part of the specification of government policy, IMR is endogenously determined in the CGE model and urbanisation is specified exogenously as described above.

Adult education: The indicators of adult education attainment we use are per year increase in the percentage of adults who have completed higher education (*pyihep*) and per year increase in the average years of schooling (*pyiays*) as shown in Equation 6 and 7 respectively. The study done by Bhakta (2015) utilised micro level Consumption Expenditure Survey (CES) data collected by the NSSO from four quinquennial rounds viz., 55th (1999-2000), 61st (2004-05), 66th (2009-10) and 68th (2011-12) to analyse the determinants of educational achievements across 26 major states in India. The child educational attainments are estimated on per capita real public expenditure in education sector after controlling several socio-economic variables. She used fixed effect panel data modelling technique to show that *pyihep* and *pyiays* are significantly influenced by public expenditure in higher education ($gehep$) and per capita government expenditure on education ($pyipcgee$), respectively. The estimated relationships also showed that per year increase in GDP in industry and services ($pyigdpisp$) and proportion of non-agricultural sector in total GDP ($gdpisp$) are important pull factors that significantly affect *pyihep* and *pyiays* respectively.

Other determinants of adult education attainment include variables reflecting the social structure (per year increase in the proportion of Hindu population ($pyihindup$), proportion of Scheduled Castes population ($pyinscpa$) and proportion of Scheduled Tribes population ($pyist$)) and demographic structure (per year increase in sex ratio ($pyisr$) and dependency ratio ($pyidr$)), apart from state fixed effects.

In the CGE model, we use these econometrically estimated relationships but with the intercept terms suitably recalibrated to adjust for the fixed effects as described earlier. The equations we specify in the CGE model for the two indicators of adult educational attainment are as follows:

6. $pyihep_t = \alpha_{hep} + \beta_{hep1}\, gehep_t + \beta_{hep2}\, pyihindup_t + \beta_{hep3}\, pyist_t + \beta_{hep4}\, pyisr_t + \beta_{hep5}\, pyidr_t + \beta_{hep6}\, pyigdpisp_t$

7. $pyiays_t = \alpha_{ays} + \beta_{ays1}\, pyipcgee_t + \beta_{ays2}\, pyistp_t + \beta_{ays3}\, pyihhilrp_t + \beta_{ays4}\, pyidr_t + \beta_{ays5}\, pyinscpa_t + \beta_{ays6}\, gdpisp_t$

8. $gays_t = pyiays_t / ays_{t-1}$

During simulations, the values of the right hand side variables in the above equations are specified as follows: The two public expenditure variables ($gehep$) and ($pyipcgee$) are part of the government policy specification in each simulation. Thus, our approach allows us to capture the potential impact that government policy on adult education has on adult education levels, and in turn on child health and education outcomes. The two variables capturing the structure of the economy, viz., $pyigdpisp$ and $gdpisp$ are both endogenously determined in the CGE model from the endogenously determined sectoral value added. Thus, our approach endogenises the feedback between change in the structure of the economy and education attainment of adults. The other exogenous variables such as land ownership and those reflecting the social structure and demographic structure are updated using exogenously given growth rates as per their respective historical trends. The last equation (Equation 8) gives the growth rate in *ays*, which is used in the next section to determine the composition of labour supply by education levels as described below.

2.3 Inter-temporal updating module

While solving the core CGE model for any particular year, values of several other variables for that year are kept fixed at exogenously specified levels. Such exogenous variables include population, factor supplies and factor endowment distribution, government consumption, stocks, the levels of foreign remittances, etc. In the second module we update the values of these exogenous variables from one year to the next. Three types of equations are used in this updating module: (a) link equations that update the relation between investment in one year and the addition to supply of sectoral capital stock in next year and the endowment distribution of capital across various agents, (b) econometrically estimated relationships relating to total stock of labour in the economy and across household classes, and (c) exogenously specified growth rates to update other parameters such as foreign capital flows, tax rates, government expenditure, etc.

Linking education levels of adults to composition of labour supply: As mentioned earlier, in our CGE model we have linked the composition of labour supply to the progress in adult education attainment. This feature has enabled us to capture important feedbacks that exist between progress in education – labour supply changes – labour market outcome – economic performance – progress in education. Here we describe how this is carried out in our model.

First, total labour supply (ls) is projected using the growth rate (ng) of working population (Equation 9) which is taken from the projection of labour force and employment by the Planning Commission (Government of India, 2008). The Planning Commission (Government of India, 2008) provides information on the anticipated growth rate in the size of the total labour force in the country between the years 2002 and 2022. The annual rate of growth in the labour force is forecast at five yearly intervals: 2.28 per cent between 2002 and 2007; 1.92 per cent (2007-2012); 1.60 per cent (2012-2017); and 1.23 per cent (2017-2022). To the best of our knowledge this is the only available forecasts of the growth in labour force in the country. No such forecasts are available for the size of labour force by skill level. Hence, we first use the above information to project the total labour force in the country between 2011-12 and 2030-31, the simulation period of our study. It may be noted here that the above Planning Commission estimates suggest a slowdown in the growth of the labour force between 2012 and 2017, and further between 2017 and 2022, for the intervening years we specify a linear reduction in the annual growth rate of labour force to the above levels. For the years beyond 2021-22, we use a constant 1.23 per cent annual growth rate of labour (Table 2).

Second, the initial composition of labour supply across labour types is calculated from the SAM for the base year 2011-12, which is then updated in subsequent years using the econometric relations estimated in the study done by Bhakta (2015) as follows:

- We assume that the proportion of skilled labour (lp_{skl}) increases annually at the same rate as the annual increase in percentage of adult population that has completed higher education as projected by the equation for *pyihep* as projected in Equation 6 above. Equation 10 captures this assumption.

- Similarly, in Equation 11 we assume that the proportion of semi-skilled labour (lp_{sskl}) grows at the same rate as the annual growth in *ays* as projected by the equation for *pyiays* described in the previous section.

Thus, through the econometrically estimated equations, we update the shares of the three types of labour in the total labour force. It may be noted that we are not directly projecting the annual growth in the stock of the three labour types.

Third, we apply the updated shares of the skilled and semi-skilled labour types on the projected stock of total labour force obtained in step one above (Equation 9) to generate the updated supply (i.e., the stock) of skilled (Equation 12) and semi-skilled labour (Equation 13).

Finally, the supply of unskilled labour (*lsus*) is obtained residually as shown in Equation 14).

9. $ls_{(t+1)} = (1 + ng) * ls_t$

10. $lp_{skl\,t+1} = lp_{skl\,t} + pyihep_t$

11. $lp_{sskl\,t+1} = lp_{sskl\,t} * (1 + gays_t)$

12. $lss_{(t+1)} = ls_{(t+1)} * lp_{skl\,t+1}$

13. $lsss_{(t+1)} = ls_{(t+1)} * lp_{sskl\,t+1}$

14. $lsus_{(t+1)} = ls_{(t+1)} - lsss_{(t+1)} - lss_{(t+1)}$

Supply of capital stock: Being a neo-classical savings driven model, we do not have a detailed characterisation of investment by agents. All that the core CGE model solves is the total gross fixed capital formation across all types of capital and by all agents in any given year. A critical task here is to (i) disaggregate this total investment into that undertaken by each domestic agent in the economy (households, private and public enterprises, and government), (ii) work out their new levels of endowment of different types of capital (this would determine their factor incomes in the next year), and (iii) work out the total stock of each type of capital available for production activities in the next year.

Towards this, first the total fixed capital investment undertaken by domestic agents in real terms is worked out by deducting the amount of foreign savings from the total gross fixed capital formation as determined by the core CGE model. Second, this real domestic gross fixed investment is divided into investments by private enterprises, public enterprise and government based on their actual shares in investment in the base year estimated from the National Accounts Statistics (NAS). Total investment by all households are then worked out residually and distributed across household types based on their shares in total household savings and their initial share in the total endowment of capital. Third, for each agent, their total investment is allocated across different types of capital. For private enterprise and households this is done based on the relative return of the different capital types as endogenously determined in the core CGE model. For public enterprise and government this allocation is done based on exogenously specified shares that reflect policy priorities of the government. Fourth, agent-wise the initial endowment of different capital types are updated based on their current period's investment by capital type and agent-specific depreciation rates worked out from the NAS. Finally, we define capital stock in three broad sectors, viz. agriculture, industry and services. In this model we assume that capital is mobile within broad sectors but immobile across broad sectors. For each capital type the total supply available for production activities in the next year is obtained as the sum total of corresponding agent-specific endowments.

Other exogenous variables: The values of various other exogenous variables such as population (total, rural and urban), sectoral inventory requirements, the levels of foreign remittances, foreign capital flows in foreign currency units, etc., are updated using growth rates derived from historical data. The rules for updating government consumption in health, education, water and sanitation are actually part of the scenario specification and these are described later in Section 3, whereas government consumption in other sectors follow same historical growth rate in the future as well.

3. Policy scenarios

Business as Usual (BAU) scenario: The BAU scenario reflects the trajectory that the Indian economy is most likely to take over the next two decades starting from 2011-12 given the current structural characteristics of the economy. The simulation period can be categorised into historical period (2011-12 to 2014-15) and future time period (2015-16 onwards). We have calibrated the initial parameter values using the SAM for the period of 2011-12, which is the base year of the model. We have then calibrated several key parameters such as production function parameters, savings propensity, trade shares, stock demand, government consumption and transfers to households, remittances, etc., such that the model outcomes in the BAU scenario for the historical time period replicates the actual observed values of some key macroeconomic variables. In particular, the annual growth rates of aggregate and sectoral GDP, exports and imports, the sectoral shares of agriculture, industry and services in total GDP; and the shares of exports, imports and current account deficit in total GDP are tracked for the historical period. Here the exogenous variables are assumed to follow the historical trend for the subsequent period using the data for the period of 2011-12 to 2014-15.

After considering the recent improvements in ease of doing business and the future projection of growth rates by the World Bank, UN and Government of India in 2015, we expect that the growth rate of the economy would improve steadily from the current levels and reach a steady state growth rate of 8.5 per cent under BAU scenario from 2017-18 onwards.

Under the BAU scenario, the current pattern of sectoral growth is assumed to prevail, viz., share of services in total GDP grows steadily, while agriculture and industry lose their share in total GDP. In case of exports and imports, we assumed that the current policies prevail in the future and the share of exports and imports in total GDP are growing very slowly. We have maintained trade deficit in both goods and services at around 3.5 per cent of GDP which is financed by remittances, government foreign borrowings, net factor income from abroad and capital flows. Exogenous growth rates are assigned for all these components except foreign capital flows which adjust to ensure the equilibrium in balance-of-payment (BOP). The trade flow parameters are calibrated such that foreign capital inflows remain at around 1 to 1.5 per cent of GDP.

In the BAU scenario, we assume that the government maintains strict fiscal discipline even as its policies with regard to taxation, public expenditure and transfers to households prevailing in 2011-12 are assumed to continue. Specifically, government consumption and transfers to households are assumed to grow at around 9 to 12 per cent per annum in real terms (Table 3). Further, existing public policies in key social sectors such as health, education, water and sanitation, public spending in particular, are assumed to be same as those prevailing in the historical time period.

The population growth rate and its composition across rural and urban areas are taken from the UN population projections as mentioned in Table 3. The total supply of labour is projected using the growth rates reported in Planning Commission (Government of India, 2008) and the composition of the labour force by skill level is endogenously determined based on education attainment as explained earlier.

On the saving-investment side, both household and enterprise savings are assumed to grow marginally over the period and government savings remain stable to maintain fiscal discipline while foreign savings is determined through the BOP equilibrium. Then total investment of the economy is determined by total savings which combines private, government and foreign savings.

Total investment in each sector is determined endogenously in the model on the basis of relative returns of that sector in last year. Thus total investment is reallocated in each year across sectors depending upon their performance in the previous year.

The BAU scenario (and in fact all the scenarios considered here) is simulated for as many years as required to achieve the IMR target of 10 per 1000 live births or less and DOR target of 1 per cent or less. That is, the simulation horizon depends upon the IMR and DOR outcomes.

Table 3: Specification of growth rates (%) of exogenous variables in the BASE scenario

Year	Population			Total labour force	Government consumption	Trasfer to households	Government foreign borrowings	Remittances to households	Factor income	
	Rural	Urban	Total						Inflows	Outflows
2011-12	0.8	2.5	1.4	1.9	4.0	26.1	-1.0	1.4	5.0	50.0
2012-13	0.7	2.4	1.3	1.9	13.0	10.0	-0.3	1.8	-10.0	10.0
2013-14	0.7	2.4	1.3	1.8	10.0	24.0	10.0	1.2	5.0	70.0
2014-15	0.7	2.4	1.3	1.7	8.0	10.0	10.0	1.0	5.0	5.0
2015-16	0.6	2.5	1.2	1.7	12.0	10.0	-1.0	1.0	5.0	-20.0
2016-17	0.6	2.4	1.2	1.6	12.0	10.0	-1.0	1.0	5.0	-30.0
2017-18	0.5	2.4	1.2	1.5	10.0	10.0	-1.0	1.0	5.0	5.0
2018-19	0.5	2.4	1.2	1.5	12.0	10.0	-1.0	1.0	5.0	-50.0
2019-20	0.5	2.3	1.2	1.4	10.0	10.0	-1.0	1.0	5.0	5.0
2020-21	0.4	2.4	1.1	1.3	10.0	10.0	0.1	1.0	5.0	5.0
2021-22	0.4	2.4	1.1	1.2	12.0	10.0	0.1	1.0	5.0	5.0
2022-23	0.3	2.3	1.1	1.2	9.0	10.0	0.1	1.0	5.0	5.0
2023-24	0.3	2.3	1.1	1.1	10.0	10.0	0.1	1.0	5.0	5.0
2024-25	0.3	2.2	1.0	1.0	9.0	10.0	0.1	1.0	5.0	5.0
2025-26	0.2	2.3	1.0	1.0	10.0	10.0	0.1	1.0	5.0	5.0
2026-27	0.1	2.2	1.0	0.9	9.0	10.0	0.1	1.0	5.0	5.0
2027-28	0.1	2.2	0.9	0.8	10.0	10.0	0.1	1.0	5.0	5.0
2028-29	0.1	2.1	0.9	0.8	9.0	10.0	0.1	1.0	5.0	5.0
2029-30	0.0	2.1	0.9	0.7	7.0	10.0	0.1	1.0	5.0	5.0
2030-31	-0.1	2.1	0.9	0.7	7.0	10.0	0.1	1.0	5.0	5.0
2031-32	-0.1	2.1	0.8	0.6	7.0	10.0	0.1	1.0	5.0	5.0
2032-33	-0.1	2.1	0.8	0.5	7.0	10.0	0.1	1.0	5.0	5.0

Source: Authors' estimates

BAU-Low (BAU-LO) Scenario: In this scenario, the steady state growth is assumed to hover around 7.5 per cent which may arise due to the non-recovery of the rest of the world in terms of foreign direct investment (FDI), foreign portfolio investment (FPI) and export demand for Indian goods and services, and/or the slow progress in economic reforms in the country that does not unleash investments. Here other exogenous variables and parameters are following same growth rates as in the BAU scenario. This scenario helps us to assess if a slower growth rate of the economy significantly extends the time taken to achieve the IMR and DOR targets.

BAU-High (BAU-HI) Scenario: Under this scenario, the economy is assumed to move to a higher steady state growth rate of 9.5 per cent in the following decade. This could be facilitated by the improvements in social sector indicators, reforms in the government policies, rules, governance, etc., that improves the ease of doing business. This in turn could build confidence among investors and attract more FDI and FPI under the make in India project in near future. Additionally, major expansion of public expenditure in several infrastructure projects undertaken by India can also help the economy to reach a higher steady state growth rate in the years to come. This scenario helps us to assess if progress in IMR and DOR can be hastened by concentrating efforts on achieving a faster growth rate of the economy without any other sectoral intervention.

Focused water and sanitation (FWS) scenario: The objective of this scenario is to assess the feasibility / sustainability of additional public spending on both water and sanitation and its potential to hasten the progress in IMR and DOR. Starting from the specification as in the BAU scenario, in this scenario public expenditure on water and sanitation has been doubled from the level prevailing in 2014-15 over four years 2015-16 to 2018-19, and is maintained at the elevated level thereon. As of 2014-15, public expenditure on water and sanitation stood at 0.4 per cent of GDP at constant 2011-12 prices. Thus, doubling of public expenditure on these sectors involve an increase in total government spending by merely 0.4 per cent of GDP in 2014-15 over four years. This, in turn, has increased per capita public expenditure in water and sanitation (*pcrews)* which has direct impact on the percentages of households with access to safe drinking water and sanitation facilities through Equations 1 and 2, respectively. Subsequently, these will improve child health and then, child education in the country through Equation 3 and 5, respectively (as mentioned in Section 2.2).

Here, we have assumed that government has financed this additional amount through public borrowings. Given that we do not have explicit markets for borrowing / lending in the CGE model, the public borrowing mode of financing additional government expenditure manifests as a decrease (increase) in government savings (dis-savings), and to that extent the total national savings would decline with its attendant consequence on total investments, accumulation of capital stock and future economic growth.

We simulate this scenario for as many as years as required to achieve the above mentioned IMR and DOR targets. Over this simulation period, we assess the feasibility / sustainability of additional public spending on both water and sanitation in terms of its impact on various macroeconomic variables mentioned earlier. Further, we also examine the progress in access to safe drinking water and sanitation facilities at own residence over the simulation horizon. However, we do not carry out the simulations to see how many years it takes to achieve universal access to safe drinking water and sanitation facilities at own residence.

This scenario partly resembles the Swachh Bharat Abhiyan (SBA) or Clean India Mission, which was launched in 2014 to eliminate open-defecation, conversion of unsanitary toilets to pour flush toilets, eradication of manual scavenging, provision of modern and scientific waste disposal system, driving cleanliness and raising awareness among citizens about sanitation and its effect on public health. The SBA does not include the provision of safe drinking water, whereas in this scenario the additional public expenditure is towards the provision of both safe drinking water and sanitation facilities at own residence.

Focused Health (FH) scenario: In this scenario we are concerned with the potential of public expenditure on health to improve IMR and indirectly on DOR through the latter. Starting from the BAU, we specify that the government has increased public spending in health sector through supplementary nutrition programme (SNP) by the same amount as in the FWS scenario; i.e., 0.4 per cent of GDP over the four years 2015-16 to 2018-19 and maintain it at the raised level from then on. This has also increased per child expenditure on SNP (*pcesnp*). That will in turn have positive impact on child health outcome (see Equation 3) as it targets only children in the age-group of 0-6 years.. This will also have an additional impact on child education indirectly through Equation 5. As in the FWS scenarios, the additional expenditure is financed through public borrowings.

Focused Education (FE) scenario: In this scenario we are interested in the impact of government expenditure on education on IMR and DOR via its impact on elementary and adult education attainment. For this, we increase public expenditure on education by the same amount as in the FWS scenario over the four years 2015-16 to 2018-19 and keep it at the elevated level later on. Again the additional expenditure is over the corresponding BAU levels and is financed through public borrowings. We then track the impact of this additional expenditure on the indicators of adult education attainment and eventually IMR and DOR.

There are several routes through which expenditure on education have impacted the educational outcomes. Notably, in Equation 5, per child expenditure on elementary education has direct impact on dropout rates in the primary level. The increase in public expenditure on education (captured through *gehep and pyipcgee)* has also impacted the literacy rate and percentage of adults completed higher education. These are captured in Equations 6 and 7. The change in literacy rate has positive impact on child health as mentioned in Equation 3. Additionally, the educational attainment will change the composition of labour which will have indirect impact on both child education and health outcome through per capita GDP.

Combined water, sanitation, health and education (ALL) scenario: This scenario is a combination of the FWS, FH and FE scenarios described above. That is, we have given a combined shock to all these sectors to test the impact of such an integrated approach on the social indicators of interest here as well as the feasibility / sustainability of such fiscal expansion. In this scenario, total public spending is increased by 1.2 per cent of total GDP through public borrowings. This increase in expenditure over the corresponding BAU levels is specified to happen over the four years 2015-16 to 2018-19 and keep it at the elevated level later on.

4. Policy simulations: Results

Before discussing the results it is worth noting here that each of the scenarios are simulated for as many years as it takes to achieve the IMR target of 10 per 1000 live births or less and DOR target of 1 per cent or less, as stated earlier. Thus, the time horizon of each of these scenarios varies. We present the results on various variables of interest for the simulation horizon starting from the base year 2011-12. However, the discussion here focuses only on the policy simulation period starting from 2015-16 onwards. The historic period 2011-12 to 2014-15 is not of interest here, and in any case the model outcomes for these years are same across all the scenarios.

4.1 BAU scenario

Here we present some of the key results for the BAU scenario as obtained from the model. The results are shown graphically from the base year 2011-12. As mentioned earlier, the model specification and hence the outcomes for the historic period 2011-12 to 2014-15 is same across all the scenarios. Later, while discussing the results for policy simulations we focus only for the period starting from 2015-16 onwards.

Table 4 shows the projected growth rate of GDP and the evolution of the sectoral shares in GDP in the BAU scenario. For the historical period, the model projected growth rate tracks closely the actual observed growth rate. With regard to the sectoral shares, for the base year 2011-12, the model outcomes show that the three broad sectors agriculture, industry and services have a share of about 18.3%, 33.0% and 48.7%, respectively. Again, these shares are pretty close to the actual observed values for that year as per the New Series of the NAS with base 2011-12. In terms of the projections for the future, it is seen that agriculture and industry lose share by about 8.4 and 4.7 percentage points, respectively, over the 20 years starting from 2011-12, while the share of services increases by 13.1 percentage points over an already large base. By 2031-32, the shares of agriculture, industry and services in GDP are projected to be 9.9%, 28.3% and 61.8%, respectively.

Sectoral prices, however, show the converse trend. Agricultural prices rise sharply compared to both industrial and services prices (Table 4). In the base year 2011-12, the CPI for all three sectors is nearly same. By 2031-32, however, agricultural products become relatively more expensive – about 3.1 times the price of services and about 1.7 times that of industrial products. The CPI for agricultural products rises by over 78 percentage points over the period 2011-12 to 2031-32. In contrast, the CPI for services fall by about 44 percentage points while CPI of industrial products show a very mild decline (6 percentage points) during this period.

The movements in sectoral price are closely linked to their cost structure, which in turn depends upon their factor use patterns and factor prices. As mentioned earlier, the model distinguishes three types of labour, viz., unskilled, semi-skilled and skilled. While all sectors use all these three labour types, the share of each labour type varies across the sectors, and follows from the usage pattern as captured in the SAM for the base year 2011-12. Table 4 shows the total supply of the three types of labour. The supply of unskilled labour force is projected to fall over time from about 112 million in 2011-12 to 76 million in 2031-32. In contrast, the supply of both semi-skilled and skilled labour is expected to rise over this period by 76 million and 36 million, respectively, reflecting the progress in education attainment in the country. As a consequence of the change in the supply patterns of the three labour types, the wage structure undergoes a drastic transformation. Real wages of unskilled labour rises dramatically by 8.2 times over the period 2011-12 to 2031-32 (Table 4) reflecting the shrinking supply of this type of labour. In contrast the rise in real wages of semi-skilled and skilled labour is quite modest –2.8 times in the case of semi-skilled labour and just 1.8 times in the case of skilled labour –due to the expansion in their supply which somewhat offsets the positive impact of the overall rise in productivity on their wages.

This demand pattern for the three labour types and the changes in the wage structure seen earlier affects sectoral costs. Agriculture being the largest user of unskilled labour, which witnesses the highest rise in wages, sees a sharp rise in its costs resulting in the sharp rise in its output prices seen earlier (Table 4). Similarly, industry being another major user of unskilled labour also witnesses a rise in its costs and hence price, though to a much lesser degree than agriculture. In contrast, services sector that uses the least amount of unskilled labour witnesses a decline in its cost and hence its prices relative to the other two sectors.

Table 4: Simulation Results – Macro Variables (BAU Scenario)

Macro Variables	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32
Growth Rate	-	4.9	6.6	7.3	7.8	8.2	8.5	8.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.6	8.6	8.5
Agriculture Share (% of GDP)	18	18	17	16	16	15	14	14	14	13	13	12	12	12	11	11	11	10	10	10	10
Industry Share (% of GDP)	33	32	32	31	31	31	30	30	30	29	29	29	29	29	29	28	28	28	28	28	28
Services Share (% of GDP)	49	50	51	52	53	54	55	56	57	58	58	59	59	60	60	61	61	61	61	62	62
Consumer Price Index																					
Total	102	102	100	100	101	100	100	99	99	99	98	98	98	98	98	98	98	98	98	98	96
Agriculture	100	107	110	115	118	123	126	132	139	145	151	156	160	162	164	167	168	170	171	171	178
Industry	103	104	100	100	102	102	102	101	100	100	100	100	100	100	100	100	100	100	100	100	98
Services	102	98	96	93	90	87	85	82	79	76	73	71	69	67	66	65	64	62	62	60	58
Wage index (2011-12 = 1.0)																					
Unskilled Labour	1.0	1.1	1.2	1.3	1.5	1.6	1.8	2.0	2.2	2.4	2.7	3.0	3.3	3.7	4.1	4.6	5.1	5.6	6.3	7.1	8.2
Semiskilled Labour	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.5	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.8
Skilled Labour	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8
Labour supply (million persons)																					
Unskilled Labour	112	112	111	110	109	108	107	105	104	102	100	98	96	94	92	89	87	84	81	79	76
Semiskilled Labour	107	111	115	118	122	126	130	134	138	142	146	150	154	158	162	165	169	173	176	180	183
Skilled Labour	42	44	45	47	49	51	53	54	56	58	60	62	64	66	67	69	71	73	74	76	78
Expenditures and current account deficit as a percentage of GDP																					
Private Consumption	58	58	58	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	56	56	56
Government Consumption	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	10
Investment	35	36	32	32	33	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	33
Export	25	25	25	23	22	23	24	24	25	25	25	25	25	25	25	25	25	25	25	25	27
Import	31	31	27	24	24	25	27	27	28	28	28	28	28	28	28	28	28	28	28	28	27
Current Account Deficit	4	4	0	0	1	1	2	2	1	2	2	2	2	2	2	2	2	2	2	2	0
Sources of savings (share in total saving)																					
Households	65	65	70	73	69	67	65	64	64	63	63	63	62	62	62	62	62	62	62	62	61
Enterprises	28	29	36	38	39	40	42	43	44	45	46	46	47	48	48	49	49	50	50	50	49
Government	-3	-6	-7	-11	-11	-12	-12	-12	-12	-13	-13	-15	-15	-16	-16	-17	-17	-18	-19	-18	-16
Foreign	10	12	1	0	4	4	5	5	4	5	5	6	6	6	6	6	6	6	6	6	6
Consumption pattern aggregated over all households (%)																					
Agriculture	25	24	23	21	20	19	18	17	16	15	14	13	12	12	11	10	10	9	8	8	7
Industry	35	35	37	37	38	39	40	41	43	44	45	46	48	49	51	52	54	55	57	58	60
Services	40	41	41	41	42	42	42	42	42	42	41	41	40	39	38	38	37	36	35	34	33

Source: Simulation results

The composition of GDP in terms of various types of expenditure is also shown in Table 4. Private consumption as a percentage of GDP is projected to decline slightly by about 2 percentage points over the 20-year period. Similarly, government consumption as a percentage of GDP is projected to decline by merely 1 percentage points in the terminal year compared to its initial value. Investments, exports and imports witness some kind of turbulence during the years 2012-13 to 2014-15, when all three of them witness sharp reduction in their shares. Thereafter all three of them witness a steady recovery. By 2031-32, exports is higher by 2 percentage points over its initial value, whereas both investments and imports are projected to decline by 2 and 4 percentage points respectively from their initial values. The current account deficit (CAD) as a percentage of GDP shows much greater movement over this period. In 2011-12 and 2012-13, CAD was about 3.5% and 4.5% of GDP, respectively. Thereafter, it shows a sharp correction to almost 0% during the period 2013-15. Subsequently, the CAD is hovering around 2% of GDP between 2018-19 and 2030-31. Again, it has declined to almost 1% of GDP in 2031-32 due to increase in exports and decline in imports in the same period as compared to the previous financial year.

The source of total savings in the economy by institution type is shown in Table 4. Households account for well over half the total savings in the economy, though their share is projected to come down by merely 4 percentage points from the 2011-12 level of 65.3%. The share of enterprises (private and public) in total is expected to rise dramatically to about 49% in 2031-32 from 28% in 2011-12. Government is expected to remain a dis-saver and this is expected to worsen over time. Government's share in total savings deteriorates to -16% in 2031-32 from -3% in 2011-12. Finally, the share of foreign savings shows fluctuations in the initial years, but stabilises later on at around 4% to 6% from 2015-16 onwards.

The growth in real income per capita for rural and urban households is shown in Figure 1. In the model, household specific CPI based on their respective consumption pattern is used to compute the real income. Thus, we capture the growth in nominal income and also the changes in relative prices that matter for the each household type. The figure brings out clearly rural-urban divide at each MPCE percentile groups. Indeed, on an absolute basis, the difference is starker for the top 10% MPCE group – the income of the richest rural household is only 30% (35%) of the richest urban household in the year 2011-12 (2031-32). In contrast, the poorest rural household's income was 75% (112%) of the poorest urban household in the year 2011-12 (2031-32). Over the 20 years, real income per capita grew four times for all rural households with the increase being higher for the poorer rural households than for the richer rural households. In contrast, the rise in real income per capita is less than three times for all but the richest urban households. During this time period, real income per capita increased by 3.3 times for the richest urban households. In other words, within rural inequality is projected to come down while within urban inequality is expected to rise even as rural-urban inequality is expected to decline, especially for the lower income groups.

The distribution of savings across various household classes is shown in Figure 2. In 2011-12, 84% of household savings were accounted for by the top 30% of households in rural and urban areas, with about 37% coming from the rural top 30% and the balance 47% from the urban top 30%. Over time, with real incomes growing across all households, the share household savings of the top 30% of the households is projected to come down by 7 percentage points to about 76% in 2031-32. Interestingly, the gap in the shares of rural and urban top 30% of households is projected to narrow down over time 38% for both rural and urban top 30%. Another interesting aspect of these projections is that in the terminal year the bottom 70% of rural population is projected to account for 16% of total household savings while their urban counterparts are expected to contribute only 8%.

As described earlier, the model projects commodity-wise demand through household-wise linear expenditure demand system. Table 4 shows the shares of agricultural, industrial and services products in total consumption aggregated over all households. As may be expected the share of agricultural products is projected to decline steadily over time from about 25% in 2011-12 to just 7% in 2031-32. In contrast the share of industrial products is projected to rise from 35% to 60% over this period. The share of services show a slight rise from 40% in 2011-12 to 42% in 2018-19 and then declines to about 33% in the terminal year.

The BAU scenario also shows that India will take up to the year 2029-30 with the existing public policies to reduce dropout rates in primary education below one per cent level, whereas it will take two more years (2031-32) to bring down IMR below 10 per 1000 live births (Table 5). In the final year of this scenario, 2031-32, in terms of the access to safe water and sanitation, India can achieve universal access to safe drinking water by 2031-32 but it is lagging behind in terms of sanitation facilities (Table 5). Merely 69 per cent households will have access to sanitation facility in their residence by 2031-32 (Table 5).

Thus far we have described the model projections in the BAU scenario for certain critical variables of interest. In the following sections we discuss the results of other policy simulations. The model outcomes for various variables of interest are compared with their corresponding values in the BAU scenario. The difference in the values for a particular simulation with the BAU scenario can then be described to the policy shock in that simulation as the numeraire and the macro closure remain same for other scenarios as well.

Figure 1: Household real income per capita (₹ per annum) – BASE scenario

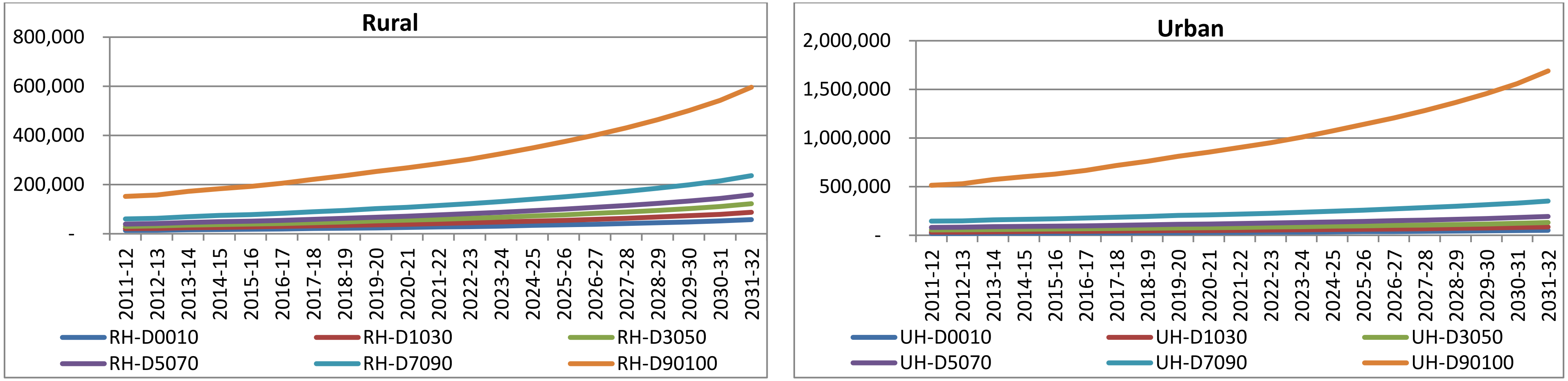
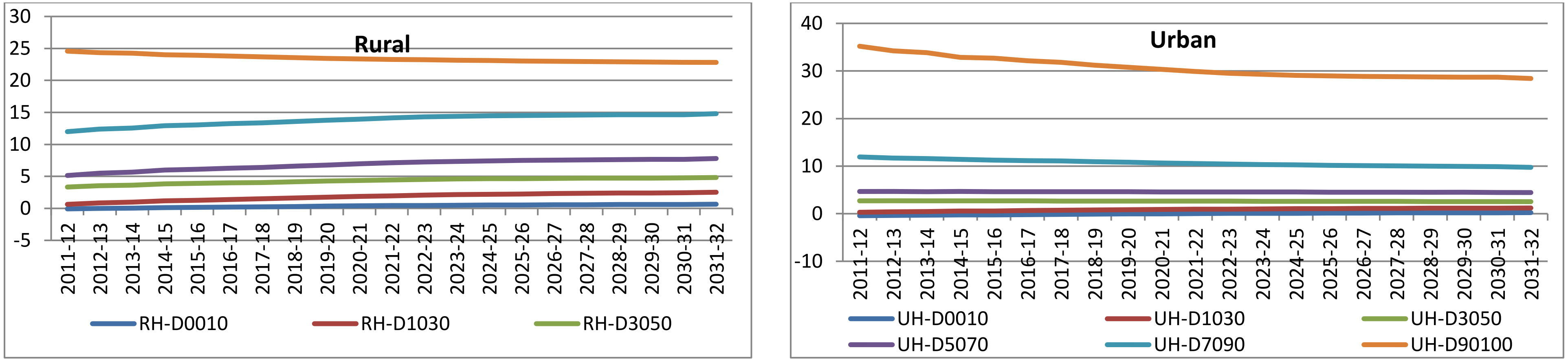


Figure 2: Share of households in total household savings (%) – BASE scenario



Source: Author's estimation based on simulation results

Table 5: Target Variables - BAU scenario

Year	DOR (%)	IMR (per 1000 live births)	Households with access to safe drinking water (%)	Households with access to sanitation facility (%)
2011-12	6.6	44.3	85.6	47.0
2012-13	6.3	42.7	86.4	48.1
2013-14	6.0	41.1	87.1	49.0
2014-15	5.7	39.9	87.8	49.9
2015-16	5.4	39.1	88.5	50.9
2016-17	5.1	37.3	89.3	51.8
2017-18	4.8	35.5	90.0	52.8
2018-19	4.4	33.7	90.7	53.8
2019-20	4.1	31.8	91.4	54.8
2020-21	3.8	30.1	92.2	55.9
2021-22	3.5	28.2	92.9	56.9
2022-23	3.1	26.4	93.6	58.0
2023-24	2.8	24.6	94.4	59.1
2024-25	2.5	22.7	95.2	60.2
2025-26	2.1	20.9	95.9	61.3
2026-27	1.8	19.0	96.7	62.5
2027-28	1.5	17.1	97.5	63.7
2028-29	1.2	15.2	98.2	64.9
2029-30	0.8	13.4	99.0	66.1
2030-31	0.8	11.5	99.8	67.4
2031-32	0.8	9.5	100.0	68.6

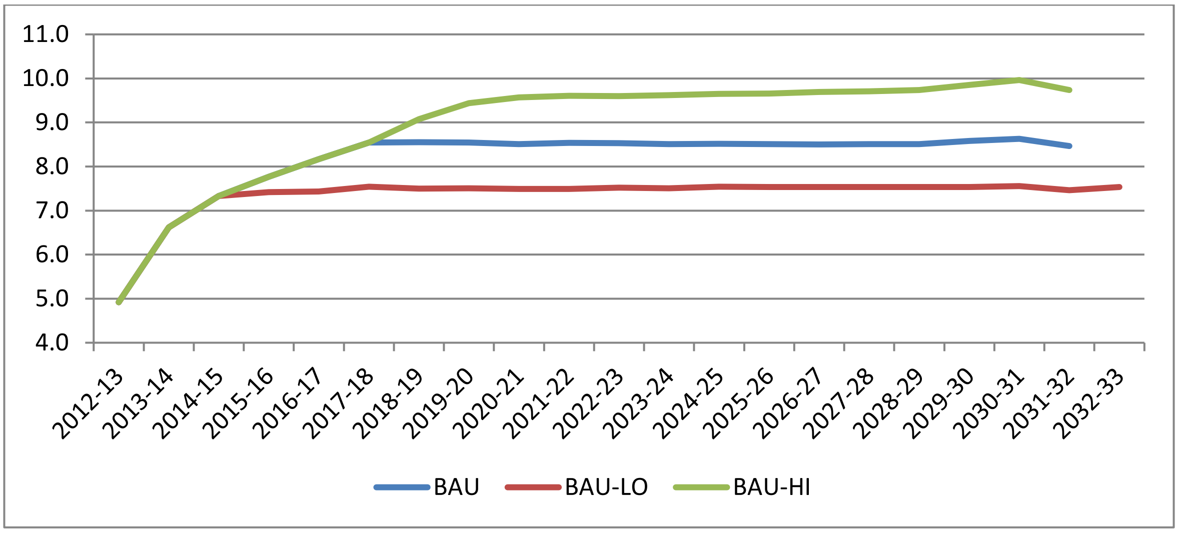
Source: Author's estimation based on simulation results

4.2 Impact of growth on the rate of improvements in the social sector

To recall, we have simulated two growth scenarios. Under the BAU-LO scenario, the steady state growth is assumed to hover around 7.5 per cent from 2014-15 onwards which may arise due to the non-recovery of the rest of the world in terms of foreign direct investment (FDI), foreign portfolio investment (FPI) and export demand for Indian goods and services, and/or the slow progress in economic reforms in the country that does not unleash investments (Figure 3). On the contrary, the economy is assumed to move to a higher steady state growth rate of 9.5 per cent from 2019-20 onwards under the BAU-HI scenario. This could be facilitated by the improvements in social sector indicators, reforms in the government policies, rules, governance, etc., that improves the ease of doing business. This in turn could build confidence among investors and attract more FDI and FPI under the make in India project in near future.

Under these two scenarios, other exogenous variables and parameters are following same growth rates as in the BAU scenario. The macroeconomic closures and the numeraire are also remaining same as in the BAU scenario that helps us to assess if change in growth rate of the economy significantly affects the improvements in child health and educational achievements given other factors constant in the long run.

Figure 3: Comparison of Growth rates in BAU-LO and BAU-HI with BAU scenario



Source: Author's estimation based on simulation results

Let us first explain the economic outcomes in these scenarios in terms of various macroeconomic indicators such as sectoral share in GDP, private consumption, savings, CPI in different sectors, real per capita income and current account deficit.

Table 6 presents the simulation results of BAU-LO and BAU-HI as percentage deviation from the BAU scenario. As in the BAU, agriculture's share falls over time across all these simulations, while that of services rises significantly, and industry's share shows a very slight fall over time. But, the movement changes slightly in BAU-LO and BAU-HI scenarios compared to BAU. Under BAU-HI (BAU-LO), share of agricultural sector is lower (higher) than BAU and the deviation increases over time to achieve higher (lower) economic growth (Table 6). The situation is quite different in case of industry and services sectors. Share of these sectors are lower in BAU-LO compared to BAU whereas share of industrial sector is higher under BAU-HI than BAU. In case of service sector, the sectoral share remains lower in BAU-HI than BAU till 2023-24 and then started increasing more under BAU-HI compared to BAU to facilitate higher economic growth in the former scenario.

The trend in sectoral share under different scenarios may have negative impact on the consumers' price index (CPI) of each sector (as can be seen in Table 6). Higher share in agriculture has facilitated to bring down its CPI under BAU-LO compared to BAU, whereas CPI of agricultural products may have increased at a higher rate due to its low share of GDP under BAU-HI than BAU. Similar trends are found for industry and service sectors.

Total savings and investment in economy is lower in BAU-LO scenario than BAU during 2018-19 to 2031-32 as enterprise savings and foreign savings are low and government dis-saving is higher under slow growth scenario than BAU. On the contrary, government dis-saving is much lower in BAU-HI than the BAU scenario which has resulted total savings to be much higher under the BAU-HI scenario than the BAU scenario during 2018-19 to 2024-25. Since 2025-26, total investment is lower in high growth scenario than BAU due to higher foreign outflows and low enterprise savings.

In BAU-LO, both private and government consumption as a percentage of GDP are higher than BAU scenario. Amongst the other components of final expenditure, the slowdown in GDP growth results in a corresponding slowdown in investment, exports and imports.

One interesting fact is that economic growth has significant impact on real per capita income. Real per capita income is much lower in BAU-LO than BAU scenario in both rural and urban areas for the entire time period. On the contrary, real per capita income is higher in BAU-HI than BAU in rural area for the entire time period and in urban area till 2029-30. Afterwards, real per capita income could not match up to the level of BAU scenario only through higher growth rate in BAU-HI.

Table 6: Simulation results of BAU-LO and BAU-HI (% change from BAU)

Variables (Unit of measurement)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
GDP-Agriculture (% of GDP)																		
BAU-LO	0.1	0.2	0.5	0.7	1.0	1.3	1.4	1.9	2.1	2.2	2.2	2.4	2.6	2.7	2.9	2.9	2.8	2.9
BAU-HI	0.0	0.0	0.0	-0.1	-0.2	-0.4	-0.7	-1.0	-2.5	-3.9	-5.0	-6.3	-7.6	-9.0	-10.8	-12.8	-12.7	-13.3
GDP-Industry (% of GDP)																		
BAU-LO	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.6	-0.7	-0.7	-0.7	-0.8	-0.8	-0.9	-1.0	-1.1	-1.2
BAU-HI	0.0	0.0	0.0	0.7	1.3	1.6	1.9	1.9	1.6	1.4	1.0	0.7	0.8	0.9	1.0	1.0	1.1	1.2
GDP-Services (% of GDP)																		
BAU-LO	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1
BAU-HI	0.0	0.0	0.0	-0.4	-0.6	-0.7	-0.8	-0.7	-0.3	0.1	0.5	0.8	1.0	1.1	1.3	1.6	1.5	1.5
CPI-Total (2011-12 = 100)																		
BAU-LO	0.0	0.1	0.1	0.5	0.7	0.6	0.9	0.5	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.3	0.4	0.4
BAU-HI	0.0	0.0	0.0	-0.1	0.0	-0.2	-0.2	-0.3	-0.3	0.0	-0.1	-0.1	-0.2	-0.1	0.1	0.1	0.1	0.2
CPI-Agriculture (2011-12 = 100)																		
BAU-LO	0.1	0.0	0.0	-0.2	-0.5	-0.8	-1.3	-1.4	-1.6	-2.1	-2.6	-3.1	-3.5	-3.9	-4.3	-4.9	-5.6	-6.3
BAU-HI	0.0	0.0	0.0	0.5	0.7	1.4	2.1	3.2	6.0	8.9	12.1	15.2	19.2	23.1	27.9	33.3	34.1	33.3
CPI-Industry (2011-12 = 100)																		
BAU-LO	0.0	0.1	0.2	0.7	1.1	1.1	1.5	1.0	0.6	0.7	0.9	1.1	1.2	1.3	1.3	1.5	1.8	2.2
BAU-HI	0.0	0.0	0.0	-0.5	-0.4	-1.1	-1.3	-1.5	-1.9	-1.9	-2.6	-3.2	-4.1	-4.8	-5.8	-7.1	-7.9	-8.4
CPI-Services (2011-12 = 100)																		
BAU-LO	0.0	0.1	0.0	0.2	0.2	0.2	0.7	0.5	0.5	0.8	1.1	1.1	1.4	1.6	1.7	2.1	2.7	3.3
BAU-HI	0.0	0.0	0.0	0.5	0.8	0.9	0.9	0.2	-1.2	-2.8	-4.5	-6.1	-7.8	-9.4	-11.1	-12.9	-13.7	-14.2
Private Saving (% of GDP)																		
BAU-LO	0.0	0.0	0.9	2.0	3.7	4.9	5.0	5.1	5.1	5.1	5.2	5.9	6.0	6.1	6.3	6.5	6.5	6.7
BAU-HI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	1.4	2.4	4.0	5.1	5.2	5.2

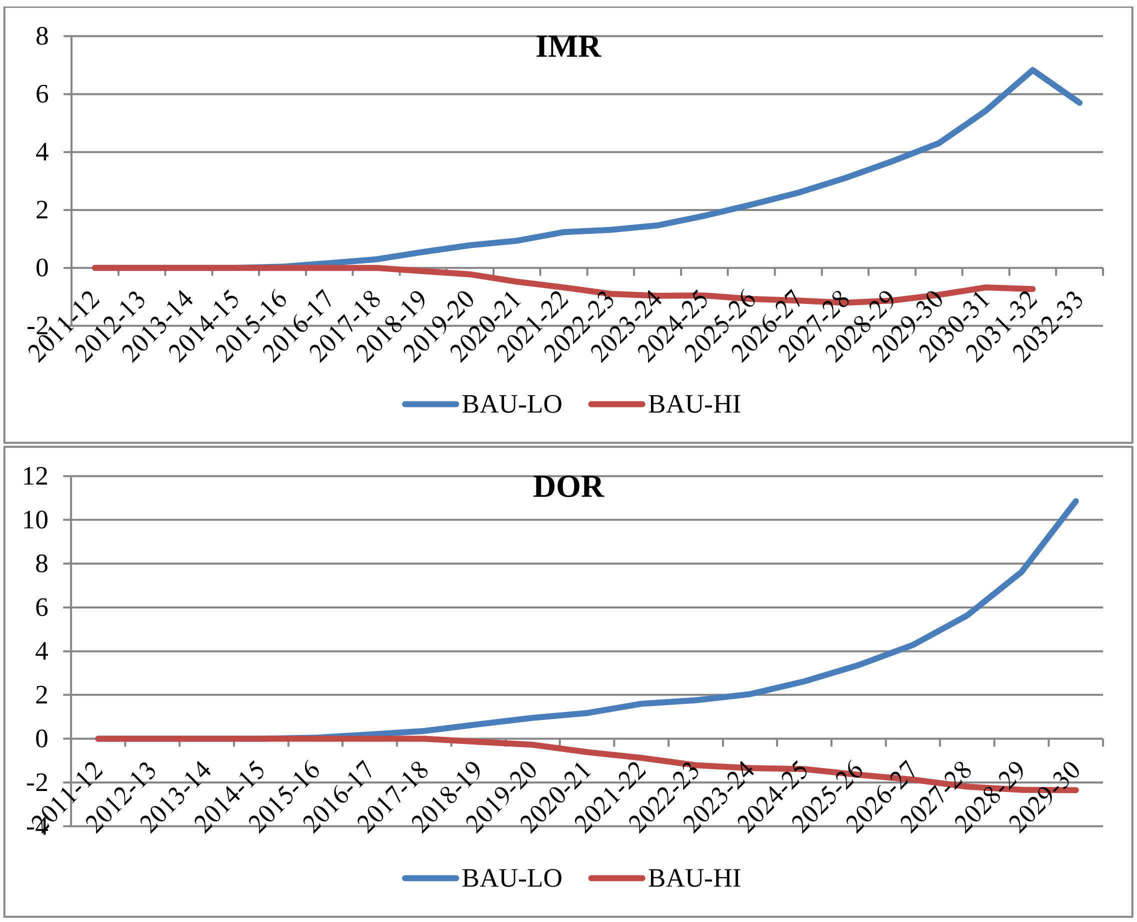
Enterprises Saving (% of GDP)																		
BAU-LO	0.0	-0.1	-0.2	-0.3	-0.5	-0.6	-0.5	-0.7	-0.7	-0.6	-0.5	-0.5	-0.4	-0.3	-0.2	0.0	0.3	0.6
BAU-HI	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	-0.5	-1.3	-2.1	-2.9	-3.9	-4.9	-6.0	-7.2	-7.7	-8.0
Government dis-saving (% of GDP)																		
BAU-LO	2.4	7.2	7.6	17.2	19.1	19.9	26.6	19.3	20.5	22.0	25.6	22.9	24.3	23.8	25.0	30.1	35.8	36.6
BAU-HI	0.0	0.0	0.0	-3.7	-7.1	-8.9	-8.7	-12.5	-8.8	-7.4	-6.2	-5.6	-5.1	-4.9	-4.0	-0.1	0.2	1.4
Foreign Saving (% of GDP)																		
BAU-LO	-14.6	-13.6	-20.4	-10.6	-3.2	-5.1	10.8	-11.5	-31.1	-28.7	-20.8	-15.7	-12.7	-7.9	-9.2	-2.3	-66.3	-24.6
BAU-HI	0.0	0.0	0.0	-3.4	17.7	-4.6	-10.4	-10.6	-10.3	0.8	-8.6	-9.2	-25.2	-23.2	-25.1	-39.1	46.4	72.3
Gross Fixed Capital Formation (% of GDP)																		
BAU-LO	-0.9	-1.6	-1.7	-1.6	-0.6	-0.3	-0.2	-0.5	-2.0	-2.1	-2.4	-1.5	-1.6	-1.1	-1.3	-1.5	-1.1	-1.0
BAU-HI	0.0	0.0	0.0	0.3	1.8	1.2	0.9	1.5	0.8	1.0	-0.1	-0.4	-1.4	-1.1	-0.9	-2.3	-3.2	-3.7
Private Consumption (% of GDP)																		
BAU-LO	0.1	0.3	0.3	0.3	0.1	-0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	0.8	0.8
BAU-HI	0.0	0.0	0.0	-0.2	-0.4	-0.7	-0.8	-0.9	-0.7	-0.4	-0.1	0.1	0.2	0.3	0.4	0.7	0.9	1.0
Government Consumption (% of GDP)																		
BAU-LO	0.4	1.3	0.2	1.7	1.0	0.9	2.4	-0.3	0.6	1.2	2.7	0.7	0.8	0.0	0.0	1.3	2.2	3.2
BAU-HI	0.0	0.0	0.0	-0.5	-1.0	-0.8	-0.1	-1.9	-0.3	-0.3	0.1	-0.3	-0.9	-2.0	-3.0	-2.3	-2.9	-2.8
Investment (% of GDP)																		
BAU-LO	-0.8	-1.5	-1.5	-1.3	-0.3	-0.1	-0.1	-0.6	-2.0	-2.1	-2.3	-1.4	-1.5	-1.2	-1.4	-1.6	-1.2	-1.0
BAU-HI	0.0	0.0	0.0	0.3	1.6	1.0	0.7	1.2	0.5	0.6	-0.4	-0.8	-1.8	-1.5	-1.3	-2.7	-3.6	-4.1
Export (% of GDP)																		
BAU-LO	-0.9	-1.5	-1.9	-3.7	-4.5	-4.1	-5.0	-3.6	-2.6	-2.7	-2.9	-2.6	-2.6	-2.4	-2.1	-2.1	-2.4	-2.6
BAU-HI	0.0	0.0	0.0	0.7	0.7	1.4	1.0	1.6	1.5	1.0	1.5	1.8	1.7	2.0	2.1	2.4	2.0	1.6
Import (% of GDP)																		
BAU-LO	-1.5	-2.0	-2.9	-3.7	-3.9	-3.7	-3.4	-3.6	-4.2	-4.0	-3.7	-3.1	-2.9	-2.4	-2.2	-1.7	-1.3	-0.9
BAU-HI	0.0	0.0	0.0	0.3	1.4	0.7	0.0	0.4	0.4	0.7	0.5	0.7	-0.7	-0.3	-0.2	-0.8	-1.8	-2.3
Current Account Deficit (% of GDP)																		

BAU-LO	-14.6	-13.6	-20.4	-10.6	-3.2	-5.1	10.8	-11.5	-31.1	-28.7	-20.8	-15.7	-12.7	-7.9	-9.2	-2.3	-66.3	-24.6
BAU-HI	0.0	0.0	0.0	-3.4	17.7	-4.6	-10.4	-10.6	-10.3	0.8	-8.6	-9.2	-25.2	-23.2	-25.1	-39.1	46.4	72.3
Real income per capita - Rural households (Rs.)																		
BAU-LO	-0.3	-0.9	-1.6	-2.9	-3.8	-4.3	-5.3	-5.3	-5.5	-6.2	-6.9	-7.5	-8.0	-8.6	-9.1	-9.8	-10.2	-10.5
BAU-HI	0.0	0.0	0.0	0.6	1.1	2.3	3.1	3.8	3.8	3.5	3.6	3.5	3.4	2.9	2.2	1.5	1.4	0.9
Real income per capita - Urban households (Rs.)																		
BAU-LO	-0.3	-1.0	-1.8	-3.1	-4.1	-4.7	-5.7	-5.8	-6.0	-6.7	-7.4	-7.9	-8.5	-9.0	-9.5	-10.2	-10.5	-10.6
BAU-HI	0.0	0.0	0.0	0.5	1.0	2.2	3.0	3.7	3.6	3.1	3.0	2.6	2.2	1.4	0.2	-1.0	-1.4	-2.0
Real income per capita - All households (Rs.)																		
BAU-LO	-0.3	-1.0	-1.7	-3.0	-4.0	-4.5	-5.5	-5.5	-5.8	-6.5	-7.1	-7.7	-8.3	-8.8	-9.3	-10.0	-10.3	-10.6
BAU-HI	0.0	0.0	0.0	0.6	1.1	2.3	3.0	3.8	3.7	3.3	3.3	3.0	2.8	2.1	1.2	0.2	0.0	-0.6

The simulation results also show that we cannot improve health and educational attainment significantly with an emphasis on overall growth rate of the economy alone. As can be seen in Figure 4, both IMR and DOR are lower (higher) in the BAU-HI (BAU-LO) scenario compared to the BAU scenario higher (lower) economic growth under the particular scenario. But, a higher growth in the BAU-HI has been able to accelerate the achievements merely by one year where both IMR and DOR achieve their target values in 2031-32 and 2029-30 respectively, one year before than BAU scenario. Similarly, a lower growth in the BAU-LO delays the achieving of each target value merely by one year compared to the BAU. Hence, both IMR and DOR achieve their target values in 2032-33 and 2030-31 respectively under BAU-LO which are similar to the BAU.

Overall, we have seen that growth oriented policies alone will not hasten progress in social sectors. Therefore, it is important to examine other policy options that would facilitate us to improve both IMR and DOR at a faster rate.

Figure 4: IMR and DOR in BAU-LO and BAU-HI (% change over BAU scenario)



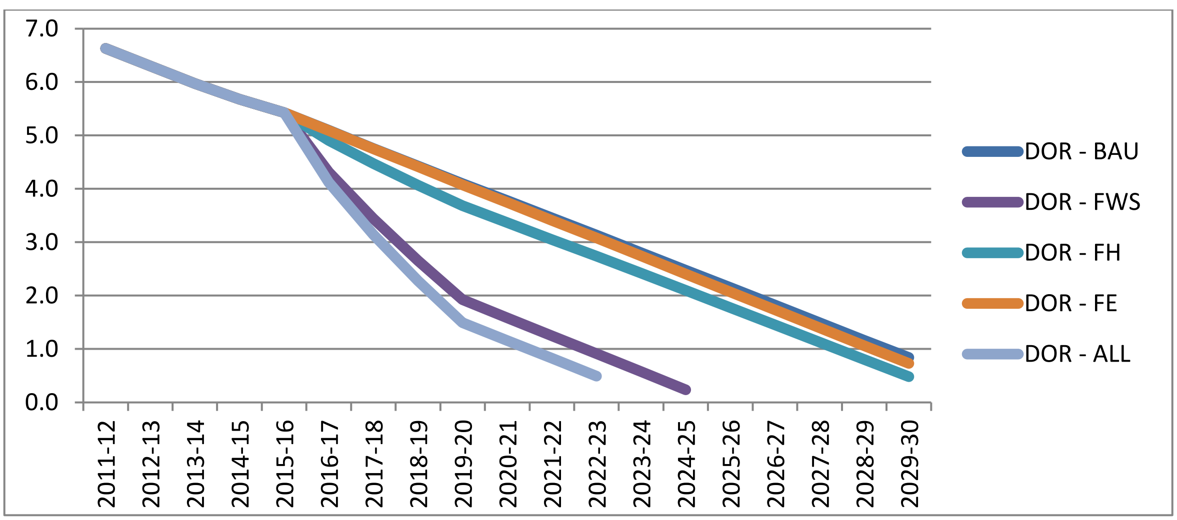
Source: Author’s estimation based on simulation results

4.3 Impact of a rise in government expenditure in health, education, water and sanitation

The simulation results of BAU, BAU-LO and BAU-Hi show that we cannot improve the situation with a mere emphasis on overall growth rate of the economy. Both BAU-LO and BAU-HI have similar progress on target indicators compared to the BAU. Hence, we have designed three alternative public policies each focusing on a particular sector viz. health, education and water & sanitation with an increment of public spending by same amount in four subsequent years.

Results show that focused water and sanitation programme has highest impact on health and educational outcomes than focused health programme or focused education programme. Additional expenditure on water and sanitation will enable 100 per cent households to have access to safe water by 2018-19, and 86 per cent households will have sanitation facilities in their residence by 2024-25. Consequently, IMR declines to below 10 and DOR to below one per cent level by 2024-25. In contrast focused health programme and focused education programmes do not have a similar strong impact on these indicators. In FHP, IMR and DOR targets are reached only by 2030-31 and 2028-29, respectively, while in FEP these are achieved by 2030-31 and 2029-30 respectively.

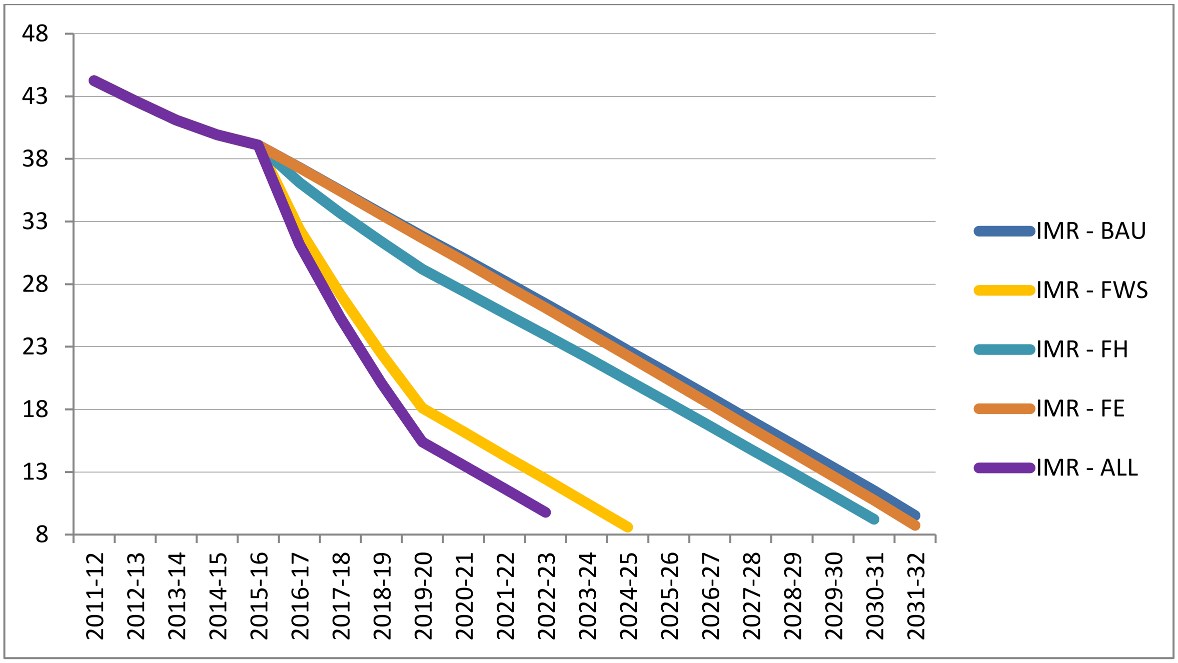
Figure 5: Scenario-wise dropout rates (DOR)



Source: Author's estimation based on simulation results

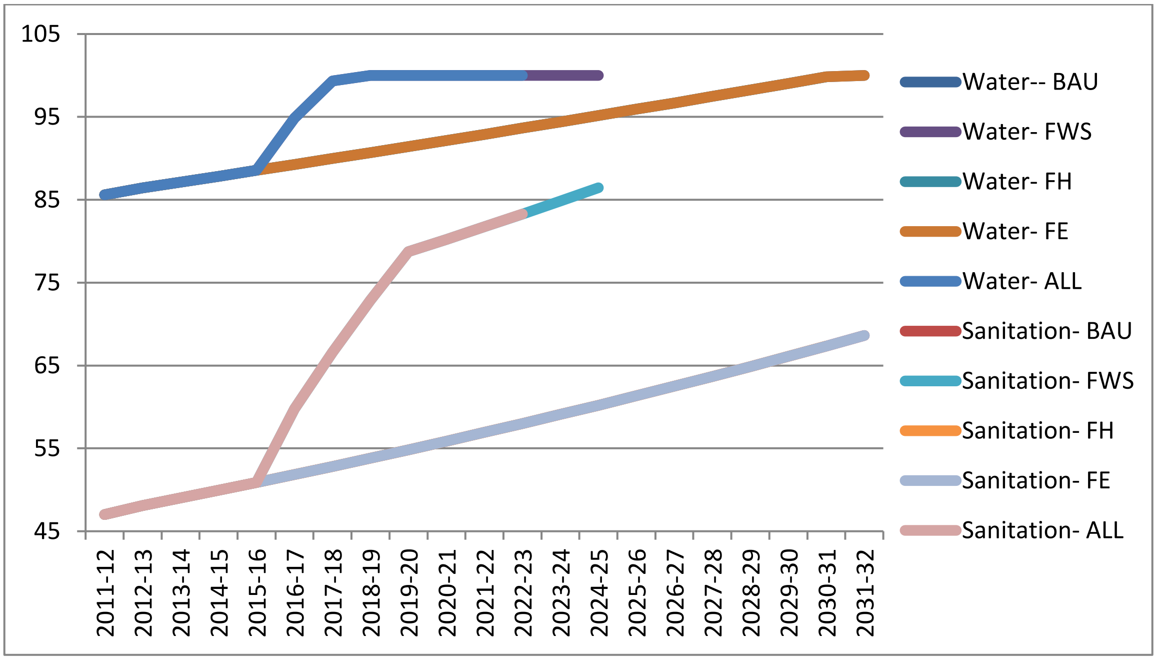
In the ALL scenario where public expenditure is expanded in water & sanitation, health and education sectors, the time taken to achieve the IMR and DOR targets falls even further to 2022-23 and 2021-22 respectively.

Figure 6: Scenario-wise infant mortality rate (IMR)



Source: Author's estimation based on simulation results

Figure 7: Scenario-wise percentages of households have access to safe water and sanitation

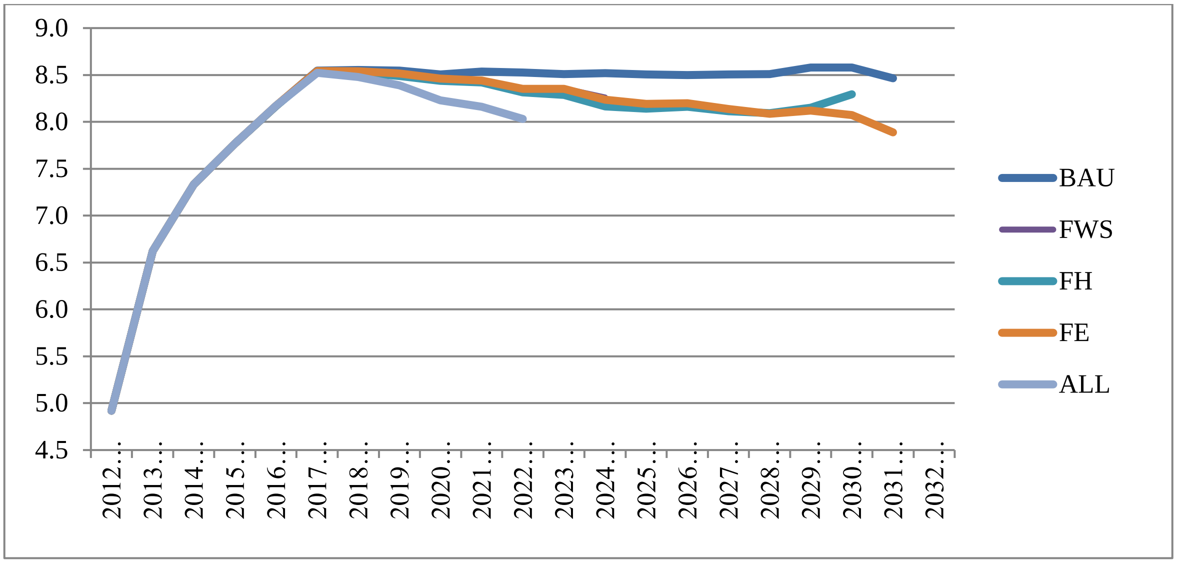


Source: Author's estimation based on simulation results

Let us now understand whether these policies are economically feasible and sustainable by examining the feedback effect of each policy scenario on key macroeconomic variables. The policy options are considered feasible/sustainable if they have least adverse impact on these macroeconomic indicators.

From Figure 8, we see that additional public expenditure on the social sectors incurred to accelerate progress in child health and educational attainment will have negative impact on the overall growth rate. This is true in all scenarios simulated here. The growth rate reduces from 8.5 per cent in BAU to as low as 7.5 per cent under ALL where we have increased public spending by 1.2 per cent of GDP.

Figure 8: Scenario-wise GDP growth rate

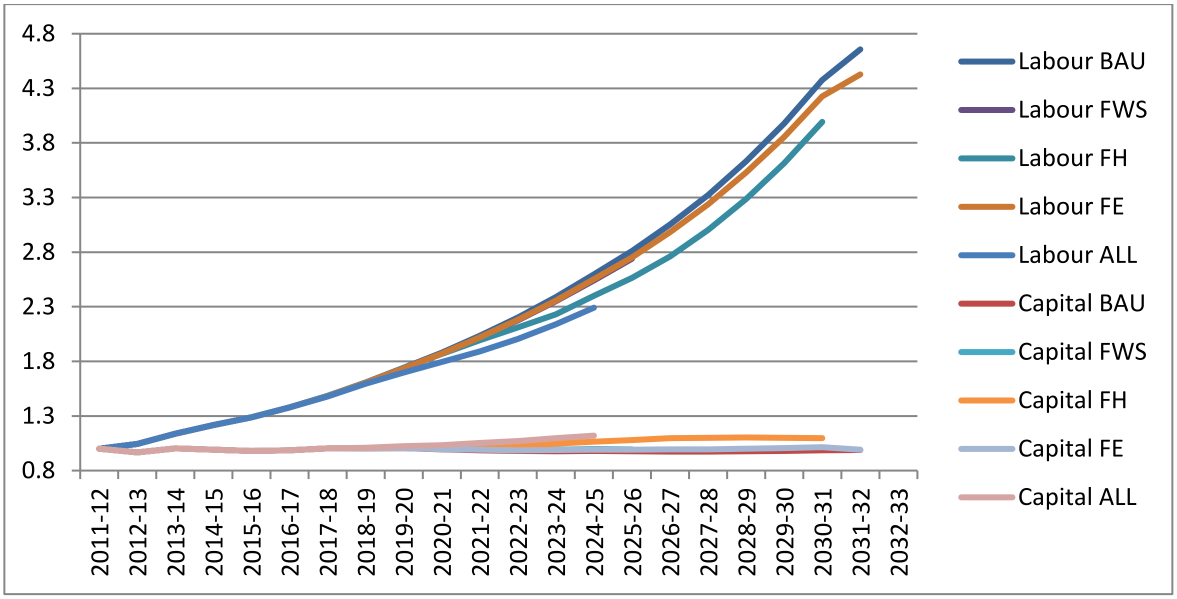


Source: Author's estimation based on simulation results

The sectoral composition of GDP, both agriculture and industry share of GDP are decreasing over time at similar speed across these scenarios whereas the share of services in total GDP is increasing over time. The percentage deviation between these scenarios and the BAU scenario lies between -6.2 to 1 per cent during this time period.

As noted earlier, a distinguishing feature of our CGE model endogenises the impact of adult education outcomes on the composition of labour supply, which in turn affects the growth trajectory of the economy via its impact on labour market outcomes, especially relative wages of the three types of labour. Figure 9 explains the change in composition of labour supply across labour types in the BAU scenario. There is a gradual increase in the labour supply of semi-skilled and skilled labour whereas unskilled labour declines over time. Other scenarios are following similar trajectory with small variation in the magnitude of growth similar to BAU scenario. The plausible reason for such marginal impact may be because of a small increase in public expenditure in each scenario. As a result, the wage rate increases at similar speed across all scenarios. But prices of capital are somewhat constant across scenarios.

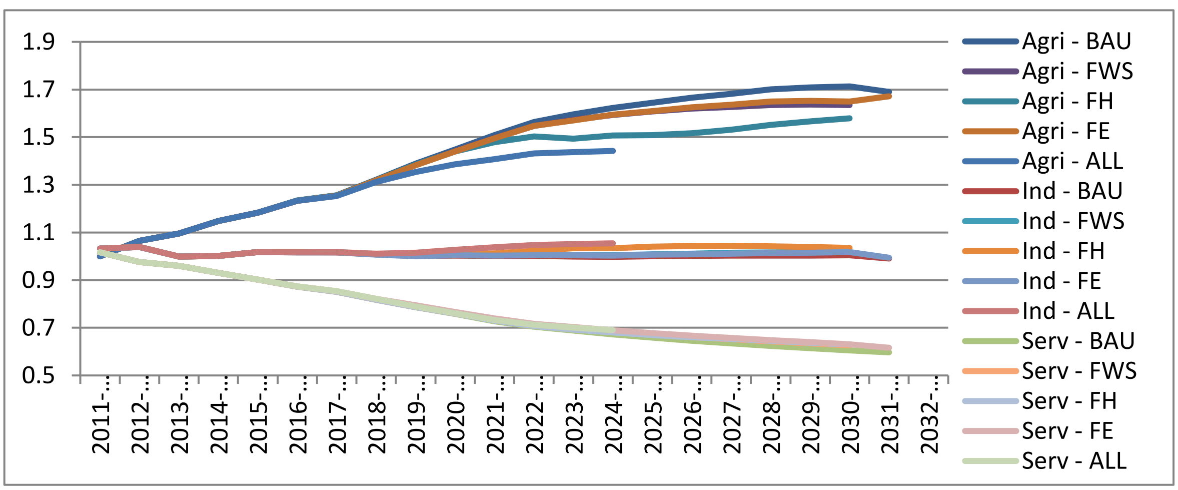
Figure 9: Scenario-wise wage index (2011-12=1.0)



Source: Author's estimation based on simulation results

The changes in sectoral composition of output and factor prices affect sectoral prices (Figure 10). In general, agricultural price rises whereas price of services falls. But industrial prices remain more or less constant in real terms. Overall, they remain stable during the simulation period.

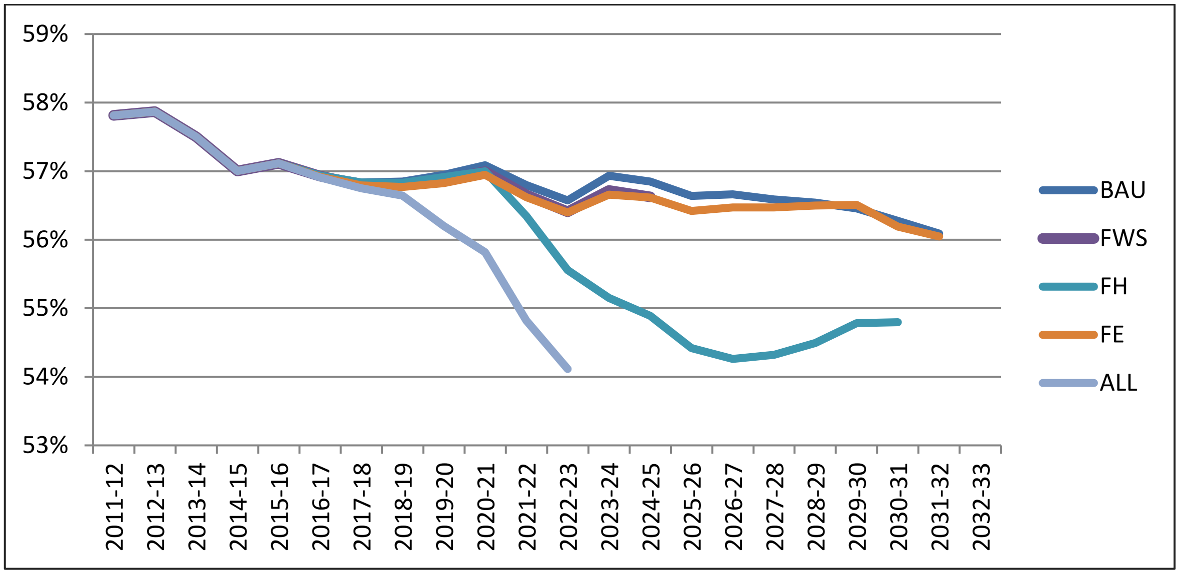
Figure 10: Scenario-wise sectoral price index (2011-12=1.0)



Source: Author's estimation based on simulation results

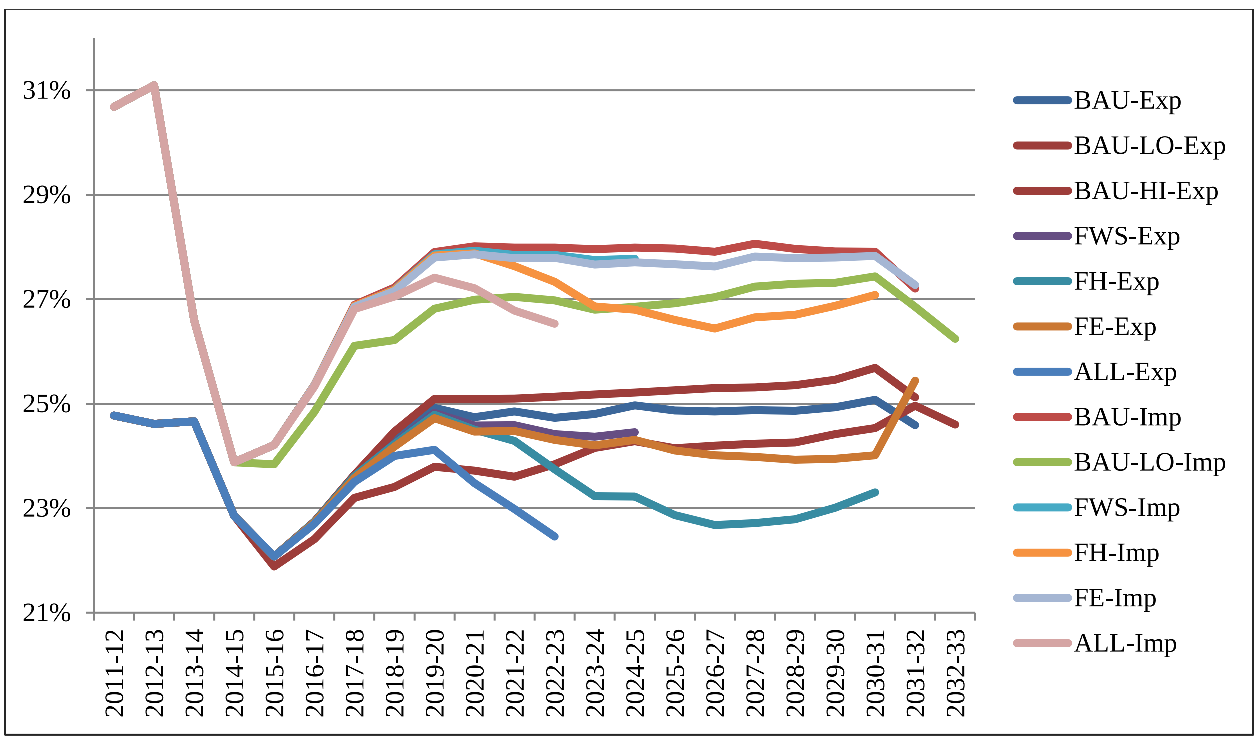
Private consumption in the BAU and in most of the scenarios has remained more or less stable at around 56-57 per cent of GDP (Figure 11), the only exceptions being FHP and ALL. In both these scenarios private consumption falls somewhat. In the final year of ALL (2022-23) private consumption is about 54 per cent of GDP, whereas in FHP share of consumption fall till 2026-27 to about 54 per cent of GDP after which it shows some recovery.

Figure 11: Scenario-wise share of private consumption in total GDP (%)



Source: Author's estimation based on simulation results

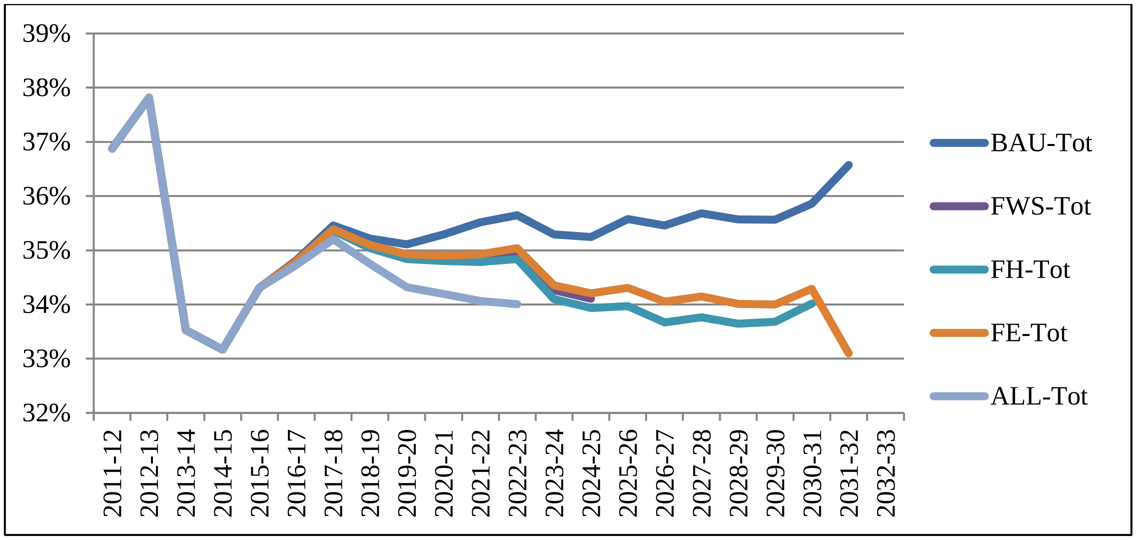
Figure 12: Scenario-wise trade shares in total GDP (%)



Source: Author's estimation based on simulation results

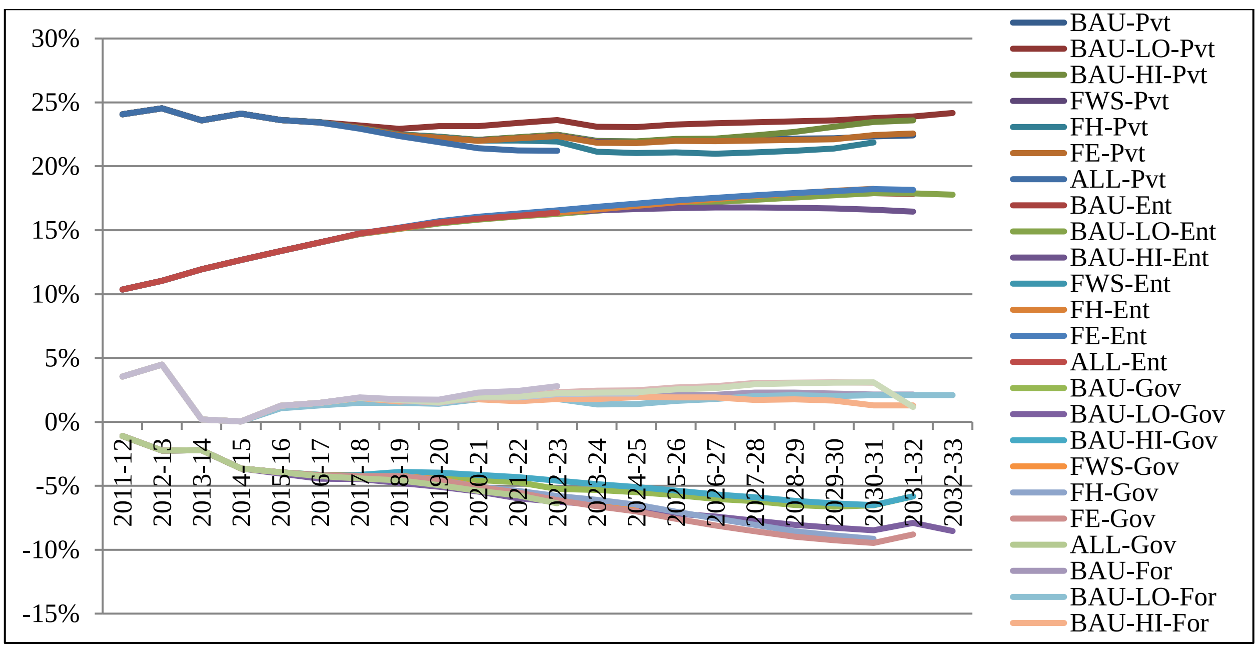
The shares of exports and imports in GDP also show a similar trajectory as private consumption across scenarios. In most of the scenarios, the shares of exports and imports in GDP hover between 24 and 28 per cent, while in terminal years of FHP and ALL they are slightly lower at about 22-23 per cent. Consequently, trade deficit also has been fairly stable in most scenarios.

Figure 13: Scenario-wise share of total savings in total GDP (%)



Source: Author's estimation based on simulation results

Figure 14: Scenario-wise share of different sources of savings in total GDP (%)



Source: Author's estimation based on simulation results

Finally, aggregate savings in the economy is seen hovering in the range of 33-36 per cent of GDP across all scenarios (Figure 13). Similarly, the private savings is fluctuating in the range of 21-25 per cent of

GDP across all these scenarios (Figure 14). Initially it declined moderately till 2025-26 then again gradually increases under all the scenarios. Enterprise savings have increased monotonously and uniformly across all the scenarios. Though government saving is seen to decline over the period, foreign saving remain stable for all scenarios.

4.4 Comparative analysis of all scenarios

A comparative picture of all the scenarios in their respective terminal years is presented in Table 7. The terminal year in each scenario is the year when IMR target of 10 per 1000 live births has been achieved. In all the scenarios, the DOR target of <1 per cent has been achieved a few years earlier than IMR target. We see that the FWS and ALL scenarios standout as better performing in terms of overall progress in all the social sector indicators including adult education outcomes, and access to water and sanitation.

Table 7: Scenario-wise comparison of target variables

Scenario	BAU	BAU-LO	BAU-HI	FWS	FH	FE	ALL
Terminal Year	**2031-32**	**2032-33**	**2031-32**	**2024-25**	**2030-31**	**2031-32**	**2022-23**
IMR (per 1000)	9.5	8.5	9.5	8.6	9.2	8.7	9.8
DOR (%)	0.2	0.0	0.2	0.2	0.2	0.1	0.5
Literacy Rate (%)	98.5	99.7	98.5	89.9	97.2	100.2	88.1
AYS (years)	9.3	9.4	9.3	8.5	9.2	9.9	8.3
HEP (%)	18.2	18.6	18.2	15.7	17.9	19.2	17.2
Water (%)	100.0	100.0	100.0	100.0	99.8	100.0	100.0
Sanitation (%)	68.6	69.9	68.6	86.4	67.4	68.6	83.3

Source: Author's estimates

Note: HEP refers to percentage of adult population who have completed higher education

Terminal year refers to the year when IMR has reduced below 10 per 1000 live births for the particular policy scenario.

In all scenarios, DOR target of <1% has been achieved much before the terminal year of the simulation.

Between these two scenarios, we see that FWS trails behind ALL in achieving the IMR target by only two years. Indeed, in the year 2022-23 (terminal year of the ALL scenario), we find that FWS is either on par or only slightly behind ALL in the social sector indicators of interest to us. The FWS values in 2022-23 for the social sector indicators are: IMR 12.4 per 1000 live births, DOR 0.9 per cent, literacy rate 87.5 per cent, AYS 8.3 years, HEP 15.0 per cent, access to safe drinking water 100 per cent, and access to sanitation in own residence 83.3 per cent.

However, in terms of impact on macroeconomic variables, such as GDP growth, per capita real GDP, private consumption, export, trade deficits, total savings and CAD, the FWS scenario has somewhat less adverse impact in the terminal year than the ALL scenario in comparison to BAU. Though, there are few exceptions like government dis-saving (capturing fiscal balance) and imports which is somewhat higher in FWS than ALL compared to BAU as shown in Table 8.

Table 8: Scenario-wise comparison of select macroeconomic variables with BAU in corresponding terminal year

Scenario	BAU-LO	BAU	Difference	BAU-HI	BAU	Difference	FWS	BAU	Difference
Terminal Year	**2032-33**	**2032-33**	**2032-33**	**2031-32**	**2031-32**	**2031-32**	**2024-25**	**2024-25**	**2024-25**
GDP Growth (%)	7.5	8.5	-1.0	9.7	8.5	1.2	8.3	8.5	-0.2
Per Capita Real GDP	2,23,371	2,49,719	-26,348	2,38,067	2,38,077	-10	1,44,722	1,46,302	-1,580
Private Consumption (%)	57.0	56.6	0.4	56.6	56.1	0.5	56.6	56.8	-0.2
Exports (%)	24.6	27.3	-2.7	25.1	24.6	0.5	24.5	25.0	-0.5
Imports (%)	26.2	26.5	-0.3	26.7	27.2	-0.5	27.8	28.0	-0.2
Trade Deficit (%)	1.6	-0.8	2.4	1.6	2.6	-1.0	3.3	3.0	0.3
Savings (%)	35.5	32.7	2.8	35.5	36.6	-1.1	34.1	35.2	-1.1
Govt. Dissaving (%)	8.5	6.2	2.3	5.8	5.8	0.0	6.9	5.5	1.4
Current Account Deficits (Rs. Crore)	-3,87,019	-5,95,582	2,08,563	-4,38,637	-8,807	-4,29,829	5,12,965	4,49,451	63,514
Current Account Deficits (% of GDP)	-1.1	-1.4	0.4	-1.0	0.0	-1.0	2.2	1.9	0.3
Scenario	**FH**	**BAU**	**Difference**	**FE**	**BAU**	**Difference**	**ALL**	**BAU**	**Difference**
Terminal Year	**2030-31**	**2030-31**	**2030-31**	**2031-32**	**2031-32**	**2031-32**	**2022-23**	**2022-23**	**2022-23**
GDP Growth (%)	8.3	8.6	-0.3	7.9	8.5	-0.6	8.0	8.5	-0.5
Per Capita Real GDP	2,09,345	2,18,240	-8,895	2,29,725	2,38,077	-8,352	1,21,585	1,28,403	-6,818
Private Consumption (%)	54.8	56.3	-1.5	56.0	56.1	-0.1	54.1	56.6	-2.5
Exports (%)	23.3	25.1	-1.8	25.4	24.6	0.8	22.5	24.7	-2.2
Imports (%)	27.1	27.9	-0.8	27.3	27.2	0.1	26.5	28.0	-1.5
Trade Deficit (%)	3.8	2.8	1.0	1.8	2.6	-0.8	4.1	3.3	0.8
Savings (%)	34.0	35.9	-1.9	33.1	36.6	-3.5	34.0	35.6	-1.6
Govt. Dissaving (%)	9.1	6.5	2.6	8.8	5.8	3.0	6.4	5.2	1.2
Current Account Deficits (Rs. Crore)	10,80,405	7,72,892	3,07,513	4,48,117	-8,807	4,56,924	5,42,362	4,00,914	1,41,448
Current Account Deficits (% of GDP)	3.1	2.1	0.9	1.2	0.0	1.2	2.8	2.0	0.8

Source: Author's estimates

In particular, the per capita real GDP (PCRGDP) will be Rs. 1,44,722 in FWS in 2024-25 which is merely Rs. 1,580 less than the PCRGDP in BAU in that year, whereas the PCRGDP will be Rs. 1,21,585 in ALL scenario by 2022-23 which is about Rs.6,818 less than the BAU scenario in the same year, which is somewhat larger than the loss in FWS. Similarly, in terms of CAD, the difference between FWS and BAU in 2024-25 is Rs.63,514 crore (i.e. 0.3% of GDP) which is quite less than the difference between ALL and BAU in the terminal year 2022-23 i.e. Rs. 1,41,448 crore (0.8% of GDP). As mentioned earlier, the gain in the number of years taken to achieve the targets for IMR and DOR is seven years in FWS, which will by additional 2 years in the case of ALL. But, in case of macroeconomic variables the FWS scenario has less adverse impacts compared to the ALL scenario. Notably, the adverse impact on per capita real GDP and CAD appear to be quite significant in the ALL scenario.

Thus in our view, amongst the various policy options considered here the FWS (increasing public expenditure on water and sanitation through recourse to public borrowing) scores over the ALL scenario (incurring additional expenditure on water, sanitation, health and education sectors financed through public borrowings). It must be stressed here that in the FWS scenario the government continues to spend on health and education sectors as in the BAU scenario; it is only the additional expenditure that is directed at the water and sanitation sector. By no means do we argue that there is no role at all for public expenditure on health and education. Spending a bit more (0.4 per cent of GDP) on water and sanitation takes the country much ahead with regard to child health and education attainments without imposing too much sacrifice in economic performance and such a policy is fiscally feasible / sustainable.

5. Conclusions and policy implications

In this study we argue that policy prescriptions on child health and education that focus on these specific sectors alone miss out on important synergies that other sectors hold for improvements in child health and education status. One plausible reason for such partial policy prescription of past studies is the analytical challenges in assessing multi-sectoral impact of alternative policy options on developmental goals relating to health and education, which are fundamentally non-economic variables. In this study we demonstrate that CGE models that are strong in accounting for intersectoral linkages combined with suitable econometrically estimated relations that capture the link between the non-economic indicators of child health and education with economic variables can help address these challenges. Such an augmented CGE model can capture the inter-sectoral synergies and come up with a richer set of policy prescription that compare alternatives to identify the most cost-effective and fiscally sustainable alternative.

To demonstrate this, we used a recursively dynamic CGE model that incorporates various interrelationships amongst health, education, water and sanitation sectors. This CGE model uses econometric relationships pertaining to IMR, DOR and education attainment of young adults (literacy rate, average years of schooling and percentage of population that completed higher education). Besides these, in the CGE model we have incorporated two simple econometrically estimated equations relating progress in water and sanitation access to public expenditure in this sector. Another notable feature of our CGE model is that we incorporate the feedback between progress in adult education and the composition of labour force in terms of the size of labour by education levels, which in turn affects future economic performance via its impacts on labour market outcomes. This feature allows us to capture the feasibility / sustainability of social sector policies in a more robust way.

Using this model, we examined alternative policy options across health, education, water and sanitation through public borrowings to identify a suitable and cost-effective policy option to achieve improved health and educational attainments of children to levels comparable to those prevailing in developed countries. Here health status of children is captured by infant mortality rate and educational attainment of children is measured in terms of dropout rates at the primary level. We set the target IMR at 10 or less and dropout rate as below one per cent, levels that are similar to those prevailing in developed countries.

We designed alternative policy scenarios to identify a suitable policy for accelerating the current rate of progress in child health and education outcomes. In particular, the policy choices that we analyse are: (i) economic growth as the driver of progress in child health and education outcomes; (ii) additional public expenditure funded through public borrowings on (a) water and sanitation sector, (b) health sector, (c) education sector and (d) combined water, sanitation, health and education sectors.

The simulation results show that under a business as usual (BAU) scenario India will take up to the year 2027-28 to reduce dropout rates below one per cent level, while it will be able to bring down IMR to 10 or below per 1000 live births only by 2031-32. In this terminal year of the simulation, while all households will have access to safe drinking water, only two-thirds of households will have access to sanitation facility in their residence. By that year, 98.5 per cent of young adults in the age group 18-40 (females) and 18-45 (males) would be literate, 18.2 per cent of them would have completed higher education and their average years of schooling would be about 9.3 years.

We developed two alternative scenarios on economic growth, BAU-LO and BAU-HI reflecting a somewhat lower (higher) growth rate than BAU to study the potential of economic growth to as a driver of progress in child health and education outcomes. The results show that we cannot improve the situation with an emphasis only on overall growth rate of the economy. Both BAU-LO and BAU-HI have similar progress on target indicators. While BAU low delays that achievement of the target values merely by one year, BAU-HI accelerates the progress only by one year compared to the BAU scenario. Thus expansionary growth policies alone will not solve the problem particularly in social sectors.

We have also designed three separate public expenditure policies each focusing on a particular sector viz. water and sanitation (FWP), health (FHP) and education (FEP). In each of these policies public spending on the particular sector is increased by same amount over four years and maintained at the elevated level later on. We also develop a fourth scenario (ALL) as a combination of the FWP, FHP and FEP scenarios, wherein public expenditure is increased simultaneously in all the three sectors. In all these scenarios, we specify that the additional public expenditure is financed through public borrowings.

Results show that FWS has highest impact on these indicators than FHP and FEP. Additional expenditure on water and sanitation will bring down IMR below 10 before 2024-25 which will have positive impact on dropout rates to reduce it below one per cent level. 100 per cent households will have access to safe water by 2017-18 whereas about 96 per cent households will have sanitation facilities in their residence by 2030. In contrast, focused health and education programmes do not have any significant impact on these indicators.

A comparative assessment of all these scenarios shows that FWS and ALL scenarios standout as best performing amongst the various policy options considered here in terms of overall progress in all the social sector indicators including adult education outcomes, and access to water and sanitation. Between these two scenarios, we find that FWS trails behind ALL in achieving the IMR target by only two years, and that the difference in the social sector achievements between these two scenarios is marginal in the year 2022-23 (the terminal year of the ALL scenario). However, in terms of impact on macroeconomic variables such as growth rate, private consumption, trade shares, and total savings the FWS scenario has somewhat less adverse impact in the terminal year than the ALL scenario.

Notably, the adverse impact on per capita real GDP and CAD appear to be quite significant in the ALL scenario compared to FWS. Compared to the BAU, the loss in per capita real GDP in FWS in its terminal year 2024-25 is merely Rs. 1,580 l, whereas it is somewhat larger at Rs.6,818 in case of ALL in its terminal year 2022-23. Similarly, in terms of CAD, the difference between FWS and BAU in 2024-25 is Rs.63,514 crore (i.e. 0.3% of GDP) which is quite less than the difference between ALL and BAU in the terminal year 2022-23 i.e. Rs. 1,41,448 crore (0.8% of GDP).

These results lead us to suggest FWS (increasing public expenditure on water and sanitation through recourse to public borrowing) as the best performing scenario amongst the various policy options considered here for accelerating child health and education attainment in the country. The FWS scenario, it must be stressed, involves the government continuing to spend on health and education sectors as in the BAU scenario; it is only the additional expenditure that is directed at the water and sanitation sector.

Spending a bit more (0.4 per cent of GDP) on water and sanitation than under a business as usual scenario can help hasten the country’s progress in bringing down IMR and DOR to levels comparable to those prevailing in developed countries in about 7 years. The economic cost of such a policy in terms of foregone economic growth and additional trade deficit is negligible; just 0.2 and 0.7 percentage points, respectively. Nor does such a policy impose a huge fiscal burden; government dis-savings increases by 1.1 percentage point only compared to the BAU scenario. This, in our view, is fiscally feasible and economically sustainable.

While explaining the above results we should keep in mind the following limitations of the study. *First*, the slow progress in health and educational outcomes of children in India may be due to lack of total capacity and inefficiency in the system which is somehow captured through econometrically estimated equations used in the CGE model. But, we could not capture lack of total capacity and inefficiency explicitly in the system. It would therefore be interesting to include certain social and economic indicators in the CGE model to measure total capacity and inefficiency of the system while analysing the slow progress in health and education sectors.

Second, there are few limitations in the recursive CGE model, such as, several exogenous variables follow same historical growth rate in the future as well. The elasticities of several equations like household consumption, savings, export, import, labour, capital, production of different activities remain same in all time periods. Similarly, the tax structure and other public policies excluding public expenditure in health, education, water and sanitation remain same in the future time period.

Third, the model does not allow for lags, beyond one year, between expenditures on health, education and factor accumulation. We can incorporate the relationship between health and educational outcomes with public expenditure in these sectors with lags beyond one year in the future study.

Fourth, the CGE model is based on a SAM for the year 2011-12, and the econometric equations incorporated into the CGE model are also based on data that is now somewhat dated. It would be useful to update all these with more recent data.

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