Business Analyst, ISSN 0973-211X, 37(2) 9-37, © SRCC

THE IMPACT OF PUBLIC EDUCATION EXPENDITURE ON ECONOMIC GROWTH AND INCOME DISTRIBUTION IN INDIA

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ABSTRACT

In this study, a multisectoral neo-classical type price driven computable general equilibrium (CGE) model, with the additional feature that it includes a mechanism by which public education expenditure to build human capital augments the supply of educated/skilled labor, is used to analyse the impact of an increase in the former, financed by an increase in direct tax rates, on economic growth and income distribution in the Indian economy. The simulation results suggest that it is possible to increase investment in education in the resource constrained fiscal environment of the Indian economy, and reap the benefits in terms of a faster economic growth and an improved income distribution. The results also suggest that secondary education needs to be accorded higher priority, though, not necessarily, at the cost of higher education. Finally, to maximize the benefits in terms of economic growth it is desirable that investment in physical capital be increased simultaneously with investment in human capital (education).

KEYWORDS: CGE model, Public Expenditure, Human Capital, Skilled Labor, Educated Labor, Education, Economic Growth, Income Distribution, India.

INTRODUCTION

A major preoccupation of policy makers in emerging economies has been to facilitate rapid physical capital accumulation with a view to spur economic growth. While promoting economic growth remains the primary concern of policy makers in emerging economies, increasingly the emphasis has shifted from economic growth *per se* to a broader goal of human development, which includes not only the income benefits of the growth process, but also the non-income benefits, such as, enhanced accessibility to educational and health services, that are critical for improving human well-being. Thus, in one prevalent view improved educational and health services are ends in themselves and therefore ought to be provided for as accompaniments to the growth process by supplementing the latter with suitable social sector policies. While this view is by no means erroneous, it is not holistic. In reality, there exists a two-way linkage between economic growth and human development. Economic growth provides the resources for amplifying access to health and education services which is instrumental in improving the quality of labor stock. A labor force with enhanced skill and productivity levels is in turn

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extremely helpful in accelerating growth. In other words, investment in human capital, apart from that in physical capital, is equally a means by which economic growth can be fostered. In fact, human capital has been identified as an important contributor to economic growth by economists, starting with Schultz (1961), and trailing down to the contemporary ones: Azariadis and Drazen (1990), Mankiw, Romer and Weil (1992), Barro and Lee (1993), De la Fuente and Domenech (2006), and Riley (2012). However, the evidence furnished by these models on the impact of human capital accumulation on economic growth varies considerably across countries (Qadri & Waheed, 2013; Hanushek and Woessmann, 2011); interestingly, the diversity in the evidence on the impact of human capital investment on income distribution is even greater (Paccagnella, 2015; Mehta *et al*, 2013). Of the many studies in this regard, we review briefly the ones pertinent to ours below.

There is a great deal of empirical evidence for economic growth being speeded up by a rise in the human capital formation through educational expansion in developing countries (Hanushek, 2013). In Nigeria, Sulaiman *et al* (2015) have found human capital in the form of secondary and tertiary school enrollments to be having a significantly positive impact on economic growth. In Brazil which is at an analogous stage of development *vis-à-vis* India, Lau *et al* (1993) attribute almost 25 percent of the economic growth to the increase in the average educational level of the workforce.

Within India, several studies (Siddharthan & Narayanan, 2013; Viswanath *et al*, 2009) have shown a positive relationship between human capital formation and economic development. More contextually, Hong and Ahmed (2009) have used state level panel data to analyze the relationship between spending on public goods such as health, education and basic infrastructure, and gross domestic product (GDP) per capita and poverty alleviation. The study found that the share of spending on public goods relative to total government spending has a positive and large impact on per capita GDP growth as well as poverty reduction. Reallocation of expenditures to raise the share of spending on public goods increases significantly both the rates of per capita GDP growth and poverty reduction.

There are also the studies dealing specifically with the impact of human capital accumulation on wage inequality. Lemieux (2006) in a regression-based study for Canada finds (unexpectedly) a widening wage differential between more educated and less educated workers over the 1980-2000 period. For U.S.A, there are a slew of general equilibrium studies on the shifts in the relative wages of labor of different educational levels, such as, Goldin and Katz (1999), Francois and Nelson (1998), Harrigan and Balban (1999) and Baldwin and Cain (1997). These studies are mostly concerned with explaining the ‘paradoxical’ effect of educational expansion on the wage inequality – i.e., increased availability of education increases rather than decrease the relative wages for skilled labor.

A significant developing countries’ study on educational attainment and wage inequality is by Mehta *et al* (2013), who show that wage inequality across more educated and less educated workers has substantially increased in India, Philippines and Thailand because in the fast-expanding services sector, demand for former has far outpaced the demand for latter, but the growth in inequality is not uniform across the three countries - inequality rises sharply in India and Thailand but not very steeply in Philippines. In Chile and Costa Rica during their respective periods of structural adjustment reforms the patterns and sources of changing wage inequalities have been analyzed and compared by Gindling and Robbins (2001) using an econometric technique. They find educational expansion to be leading to an increase in wage inequality in both countries. The disequalizing impact of educational expansion on wages across labor with different educational levels, however, was greater in Chile than in Costa Rica because of a more rapid rise in relative demand for more educated workers in the former as compared to the latter, during their respective structural adjustment periods.

Within India, several non-CGE studies analyzing the post-1991 evolution of the Indian economy have found human capital investment to be spurring growth as well as inequality in this period (Cain *et al*, 2009; Kijima, 2006; Kochhar *et al*, 2006; Dutta, 2005). Pradhan (2002) employs ex-post decomposition techniques within general equilibrium models to study the impact of education on poverty in India. In this model, which typifies a Ricardo-Viner world, he shows using Indian data for 1988 and 1997, that for a very large range of substitution elasticity parameters, education does not impact much the wage inequality.

India presently is all set to reap the demographic dividend from her very young population structure (James, 2008). The challenge at this juncture in India lies in taking utmost advantage of this emerging demographic dividend, by boosting investments in physical and human capital (with the emphasis from a public policy perspective increasingly shifting to the latter) with a view to achieve more rapid growth and reduction in inequality (poverty).

For understanding better the intricacies of this policy challenge, we turn now to the applied general equilibrium models focusing simultaneously on the growth and distributional implications of enhancing public expenditure on physical and human capital accumulation, and we find that there is a slew of such models covering many countries, but, none of them is for India. Grimm (2005) has analyzed the impact of an expansion in education in Cote d'Ivoire on the growth and distribution of income using a dynamic microsimulation model. The author finds that a policy which universalizes primary education is capable of achieving only modest gains in income growth and poverty reduction. The latter are inadequate for eradicating poverty, and, the author, therefore, suggests that expansion of education be accompanied by complementary policies such as enhancement of physical capital investment and technological progress thus creating more demand for skilled labor, in order to increase the returns to education. Rivera and Rojas-Romagosa (2009) use a top-down sequentially dynamic computable general equilibrium model to compare the impacts of trade liberalization and human capital accumulation on growth and poverty reduction in Costa Rica and Nicargua, and find that the latter has far greater effectiveness on both counts. Indeed human capital is found to be making a profound contribution to economic growth in both the countries, and is, therefore, recommended by them for top policy priority in these countries.

More closely related to the goal of this study to develop a computable general equilibrium (CGE) model to examine the impact of higher levels of public expenditure on physical and human capital on growth and income inequality in India is the paper by Jung and Thorbecke (2003). In this paper the growth and distributional consequences of enhanced public expenditure on physical and human capital are analyzed using a recursively dynamic multisectoral CGE model for two heavily indebted poor countries (HIPCs), Tanzania and Zambia. The CGE model used here is the standard neo-classical type described in Dervis, de Melo and Robinson (1982), Thorbecke (1992) and Robinson *et al* (1999), with the additional feature that three different types of labor, non-educated, primary-educated, and higher-educated labor, are combined in two stages in the production structure of the model, to reflect different levels of substitutability. The non-educated and the primary educated labor are combined within a Cobb-Douglas type Armington aggregation to produce an aggregate of unskilled labor. This unskilled-labor-aggregate is then combined with higher-educated labor within a CES type Armington aggregation to yield a composite labor measure. Profit maximizing firms employ the optimal amount of each type of labor given wage rates and the technical and budget constraints.

Another novel feature of the Jung and Thorbecke (2003) model is that its intertemporal dynamics includes a specific mechanism through which public education expenditure augments the stock of human capital. In other words, education expenditure provides additional educational capital to those who are in the educational pipeline. As these individuals come out of the educational pipeline, they acquire improved labor skills and, thereby, add to the stock of human capital.

In India too, human capital formation is largely a function of public education and health expenditure (of which we are only considering the former in this paper). Hence, the linkage between public education expenditure and inclusive economic growth is a subject of much research and debate in India. We analyse this linkage in a CGE modeling framework. Given the relevance of the Jung and Thorbecke (2003) model for our objective we have followed it for this study with some modifications that are detailed below in the section on model structure.

In spite of very impressive growth in recent years, India’s rank in the HDI (Human Development Index) is 134 among 187 countries (Human Development Report, 2011). One reason for low levels of human development in India is low levels of public spending on education (and health). According to the report, public spending on education in India is about 4.2 percent of GDP, while this figure is 4.6 percent for medium human development countries and 6.5 percent for high human development countries. Table 1 presents trends in public expenditure on education in India. In recent years the country has taken many concrete steps to address the issue of low investments in public goods. For example, the government seeks to increase public spending on education to six percent of GDP. The extra revenue required to fulfill this objective is being raised through what is called an 'education cess', but, which is essentially additional income tax whose revenue is dedicated for government expenditure on education.

Table 1: Trends in public spending on education (percent of GDP)

	2009-10	**2010-11**	**2011-12**	**2012-13**
Elementary	1.72	1.74	1.78	1.81
Secondary	0.96	0.99	1.01	1.04
University	0.58	0.61	0.64	0.66
Adult	0.01	0.01	0.02	0.02
Technical	0.57	0.60	0.63	0.65
Total	3.85	3.95	4.08	4.18

Source: Analysis of Budgeted Expenditure on Education (various years), Ministry of Human Resource Development, Government of India

Given this background, the main objective of this paper is to study the impact of a tax-financed increase in public expenditure on physical and human capital formation on GDP growth and its inclusiveness using a quasi-dynamic CGE model. We first generate a baseline or a business-as-usual (BAU) scenario, and then simulate alternative policy scenarios with higher investments in physical and human capital formation financed through the levying of additional income tax.

The rest of the paper is organized as follows. Section 2 presents the overall structure of the CGE model used in the present study, with special emphasis on the intertemporal dynamics which includes a mechanism through which public education expenditure augments the stock of human capital. Section 3 presents the main features, such as, real GDP growth and growth of household real incomes, of the base-line or the business-as-usual (BAU) scenario. In section 4, we report the simulation results of the three policy scenarios in comparison with the BAU scenario. Section 5 concludes and suggests policy implications of our results.

Model Structure

Our model is a multisectoral, neo-classical type price driven CGE model, with the additional feature that it includes a mechanism through which public expenditure on education augments the supply of human capital (i.e., educated / skilled labor). The overall structure of our model is similar to the one presented in Jung and Thorbecke (2003). However, in formulating the details of the model, we follow an eclectic approach keeping in mind the institutional features peculiar to the Indian economy.

The model has 16 production sectors and three factors of production - land, capital and composite labor, which in turn, is a nested CES aggregation of non-educated, secondary educated and higher-educated labor[1]. At the beginning of a period, the economy is endowed with a certain level of physical capital and human capital, in the form of stocks of different types of labor. In any given period the allocation of capital across production sectors is fixed, but labor is inter-sectorally mobile. Producers act as profit maximisers in perfectly competitive markets, i.e., they take factor and output prices (inclusive of any taxes) as given and generate demands for factors so as to minimize unit costs of output. The factors of production include intermediates and the primary inputs – capital, land and different types of labor. For households, the initial factor endowments are fixed. They, therefore, supply factors inelastically. Their commodity-wise demands are expressed, for given income and market prices, through the Stone-Geary linear expenditure system (LES). Also households save and pay taxes to the government. Furthermore, households are classified into four rural and five urban categories. The government is not assumed to be an optimizing agent. Instead, government consumption, transfers and tax rates are exogenous policy instruments. The rest of the world supplies goods to the economy which are imperfect substitutes for domestic output, makes transfer payments and demands exports. The standard small-country assumption is made, which implies that, India is a price-taker in import markets and can import as much as it wants. However, because the imported goods are differentiated from the domestically produced goods, the two varieties are aggregated using a constant elasticity of substitution (CES) function, based on the Armington assumption. As a result, the imports of a given good depends on the relation between the prices of the imported and the domestically produced varieties of that good. For exports, a downward sloping world demand curve is assumed. Furthermore, a constant elasticity of transformation (CET) function is used to define the output of a given sector as a revenue-maximizing aggregate of goods for the domestic market and goods for the foreign markets. This implies that the response of the domestic supply of goods in favour or against exports depends upon the price of those goods in the foreign markets *vis-à-vis* their prices in the domestic markets, given the elasticity of transformation between goods for the two types of markets. The model is Walrasian in character. Markets for all commodities and non-fixed factors - capital stocks are fixed and intersectorally immobile - clear through adjustment in prices. However, thanks to the Walras' law, the model determines only *relative* prices. The exchange rate is chosen as the numeraire and is, therefore, normalized to unity. The model determines endogenously the foreign savings in the external closure. Finally, because the aggregate investment is exogenously fixed, the model follows an investment-driven macro closure, in which the aggregate savings - i.e., the sum of household, government and foreign savings - adjusts, to satisfy the saving-investment balance.

Intertemporally, the model adjusts through changes in the stock of physical capital and the stock of human capital. Physical capital is increased by investment, which is exogenously given. Human capital is augmented by the new supply of educated labor, which in turn is a function of public education expenditure

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[1] In our classification of 3 types of labor in India, 'secondary educated' includes all those from 1st pass to 12th pass – i.e., 'elementary' + 'secondary' + 'higher secondary' educated, and 'higher educated' includes 'graduates ' + 'higher-than-graduates'.

The production structure

Our model is based on the following 16-sector disaggregation of the Indian economy : agriculture, mining, fossil fuels, electricity, energy-intensive goods, machinery, construction, other intermediates, consumer goods, other manufacturing, land transport, railway, other transport, health, education, services. Each sector has 3 types of labor inputs – unskilled or non-educated labor, semi-skilled or secondary educated labor and skilled or higher educated labor – which sum up to what is called composite labor. Production technologies for all sectors are defined using nested CES functions. At each level of the nested production function, the assumption of constant elasticity of substitution (CES) and constant returns to scale (CRS) is made. For every level, the producer's problem is to minimize cost (or maximize profit) given the factor and output prices and express demands for inputs. It follows that for every level, the following three relationships hold : the CES function relating output to inputs, the first order conditions, and the product exhaustion theorem. For all the levels taken together, the production system thus determines the gross domestic output, the input demands, value-added as well as the demands for the various types of labor. (The capital stock in a particular period is given, so the first-order condition effectively determines the sectoral return on capital).

Investment

Public and private investment are fed into the model as two distinct constituents of the total investment. There are fixed share parameters for distributing the aggregate investment across sectors of origin. However, the allocation mechanisms for sectors of destination are different in the two cases of public and private investment. For public investment there is discretionary allocation, and the allocation ratios are therefore set exogenously in the model in each period. On the other hand, for private investment the allocation ratios are *given* in a particular period, but are revised from period to period on the basis of the sectoral relative return on capital. The relative return on capital in any sector is given by the normalization of the implicit price of capital in that sector to the economy-wide returns. Note that this rule does not imply full factor price equalization, but only a sluggish reallocation of investment from sectors where rate of return is low to ones having higher rates of return.

Needless to say, all this bifurcation of total investment into its public and private components with their differing allocation mechanisms is an attempt to approximate the way investments are actually made in the Indian economy. Incidentally, it also allows for public investments to be directed towards "strategic" sectors disregarding short-run considerations of profit maximization.

Factor markets

Labor is intersectorally mobile. Wages are flexible and adjust to equilibriate the demand and supply for each of the three types of labor – non-educated labor, secondary-educated labor and higher educated labor. There is no unemployment for any of the three types of labor. Cropping land in the agricultural sector is also fully utilized at the equilibrium rent. However, capital stocks are fixed sector-wise. The optimizing behavior of producers therefore determines sector specific return on capital.

Household Income and consumption demand

There are nine household groups in the model - rural cultivator (**RC**), rural artisan (**RATN**), rural agricultural labor (**RAL**), rural others (**RO**), urban farmer (**UF**), urban non-agricultural self-employed, (**UNASE**), urban salaried (**US**), urban casual laborer (**UCL**), urban others (**UO**). The factor endowments for each household group are given. Households derive their income by selling the factors they own – land, labor (of 3 types) and capital. From these incomes, taxes are netted out and transfer payments by government and rest of the world are added to arrive at the household disposable incomes. The households are assumed to save a fixed fraction of their disposable incomes. The rest of it is spent on the consumption of goods. The consumption functions of the households are estimated by the most suitable Stone and Geary linear expenditure system (LES), which is widely used in India. Private corporate and public sectors do not have any consumption expenditure. They receive income from the rental values of non-land capital. Private corporate sector gets additional income from rental value of land and government transfer payments including interest payments.

Private corporate and public sector income

Private corporate sector income consists of its earning from factor incomes and transfers from government, which is equal to its savings. On the other hand, public sector income is defined as income from entrepreneurship (factor income from capital) that goes as transfers to government.

Household savings

The average propensity to save out of their disposable incomes is exogenously given for each of the four rural and five urban households. Households thus save a fixed part of their incomes. Total household savings in the economy is obtained by summing up the savings of all the nine household groups.

Government Savings

Government revenue originates from the following five sources : excise tax on production, sales tax on goods, import duties from imported goods and income tax from households. All the tax rates are exogenously given. Government income also includes the capital income and land rent from ownership of these factors, factor income from abroad and public sector income. Government expenditure takes place on account of government consumption and transfers to households and firms, and public sector investment, all of which are exogenously fixed. Government savings is obtained as the difference between government income and expenditure.

Foreign savings

Foreign savings in dollar terms is expressed in the model as the excess of payments for total imports over the sum of export earnings, net current transfers and factor income from abroad. The latter two, it may be noted, are exogenously given values in the model.

Market equilibrium and macroeconomic closure

Market clearing equilibrium in the commodity markets is ensured by the condition that sectoral domestic supply must equal demand faced by that sector. The sectoral domestic supply, (i.e., domestic gross output) of a commodity is determined through the nested CES function in the production structure of the model. On the other hand, sectoral demand is a combination of domestic demand and export demand, based on a CET transformation function. In turn, the aggregate demand for a commodity – i.e., the sum of consumption, investment and government and intermediate demands - is equated to the demand for a composite commodity defined as an Armington type CES aggregation of domestic demand and imports.

The model is Walrasian in spirit with the sectoral prices being the equilibrating variables for the market-clearing equations. The Walras' law holds and the model is, therefore, homogeneous of degree zero in prices determining only relative prices. The exchange rate serves as the numeraire, and is, therefore, fixed at one.

Finally, note that although the model is neoclassical in nature, it follows investment-driven macro closure in which aggregate investment is fixed and the components of savings - household savings, government savings and foreign savings - are endogenous variables and adjust to equalize saving and investment.

Inter-temporal adjustments

In the interim-period sub-model, the physical and human capital stocks are updated. Sectoral capital stocks are exogenously given at the beginning of a particular period. However, our model is recursively dynamic, which means that it is run for many periods as a sequence of equilibria. Between two periods there will be additions to capital stocks in each sector because of the investment undertaken in that sector in the previous period. More precisely, sectoral capital stocks for any year $t+1$ are arrived at by adding the investments by sectors of destination, net of depreciation, in year t to the sectoral capital stocks at the beginning of the year t. Between two periods there will be additions to human capital stocks also because of the public education expenditure undertaken in the previous period.

The flows of labor of different educational levels are interlinked with each other. From the pool of population growth (MS_1), some proceed to secondary school (MS_2), while others remain non-educated (ML_1), and from secondary school, some advance to higher education (MS_3), while others directly enter the labor market as secondary educated (ML_2). Finally, higher-educated workers are produced and supplied (ML_3). With the total increase of the labor force constrained to a fixed population growth rate, the new supply of non-educated labor (ML_1) is determined residually.

The complete set of equations of the model, which has been solved using the GAMS (General Algebraic Modeling Systems) software with its PATH solver, can be found in Ojha and Pradhan (2006).

THE BASE-LINE SCENARIO

Our CGE model has been calibrated to the benchmark equilibrium data set of the Indian economy for the year 2004[2], obtained basically from the SAM by Ojha *et al* (2005), which is then re-aggregated and modified to conform to the classification scheme of the production sectors, labor categories and the household groups, adopted in the model. Using the benchmark data set for the year 2004, we solve the CGE model first for the base-year, and, subsequently, using a time series of the exogenous variables of the model, we solve the model sequentially for the period from 2004 to 2030 to develop a baseline scenario.

Benchmark parameters

After having obtained the basic data set from the SAM, the CGE model is subjected to benchmark calibration. Calibration involves a deterministic approach to specifying parameter values in such a manner that the model solution replicates the base-year data (Shoven and Whalley (1992)). Calibration of the 'shift' and 'share' parameters of the production functions, CES aggregation function for imports and CET function for imports, however, require the elasticity parameters of these functions to be given. The elasticity parameters have been taken from different sources and are given below in table 3. Note that different types of labor are combined in two stages in the production structure to reflect different degrees of substitutability. The skilled labor composite and non-educated labor are combined within a CES type Armington aggregation that has a small elasticity of substitution equal to 0.5 to yield composite labor. In turn, skilled labor composite is a CES Armington aggregation of secondary-educated and higher-educated labor based on a larger elasticity of substitution equal to 0.8. Through this labor aggregation scheme, the model is able to capture productivity growth caused by education. Note

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[2] The year 2004, is actually the financial year 2003-04 in the Indian economic calendar, which runs from 1st April 2003 to 31st March 2004. Henceforth, we refer to a financial year in the Indian economic system by using only the second element in the hyphenated numeral used to designate that year, i.e., 2004 will refer to what is actually 2003-04, 2005 would actually mean 2004-05, and so on.

also that the higher wage income for the educated laborers results in higher share parameters for such workers in the calibration. Educated workers thereby contribute more to the composite labor. It follows that an increase in the supply of educated labor leads to a higher value for composite labor, resulting in higher production.

In table 4 we present the endowments of human capital across the nine household groups. It is interesting to note that most of the secondary and higher educated belong to the urban salaried and urban non-agricultural self-employed groups. Almost 85 percent of higher-educated and 42 percent of secondary-educated workers come from these two groups. However, secondary-educated workers are more evenly spread over the urban and rural groups. Urban groups have 48.5 percent of the secondary-educated workers and rural groups have 52.5 percent of the educated workers. (It may be noted that, in our classification of educated workers, secondary-educated includes elementary, secondary and higher-secondary educated. The distribution of workers within these three levels of education is not shown in the table.)

Table 3 : Elasticity parameters

		ρ_1	ρ_2	ρ_3	ρ_a	ρ_c	ε_{ex}
s1	Agriculture	0.7800	0.3201	0.4241	0.8000	0.9200	0.8400
s2	Mining	1.3200	0.7173	0.6723	0.8000	0.4600	0.8600
s3	Fossil Fuels	0.7420	0.5214	0.5671	0.8100	1.7000	1.2300
s4	Electricity	0.9682	0.5112	0.5542			
s5	Energy-intensive Goods	1.1000	0.4846	0.6169	2.1450	0.9200	1.2800
s6	Machinery	0.6546	0.3461	0.5246	2.1450	0.9200	1.3600
s7	Construction	1.4500	0.8342	0.7653			
s8	Other Intermediates	1.4500	0.5262	0.8157	2.1450	0.9200	1.2800
s9	Consumer Goods	1.6500	0.6791	0.8242	2.1450	0.9200	1.3600
s10	Other Manufacturing	1.0800	0.5000	0.7161	0.7150	0.3067	0.6667
s11	Land Transport	0.7345	0.4421	0.4357	0.7150	0.3067	0.6667
s12	Railway	1.0456	0.4353	0.6233	0.7150	0.3067	0.6667
s13	Other Transport	0.8342	0.4461	0.5161	0.7150	0.3067	0.6667
s14	Health	0.8726	0.2322	0.1236			
s15	Education	0.4241	0.2002	0.1056			
s16	Services	0.7256	0.6177	0.8321	0.7150	0.3067	0.6667

Note : ρ_1 : elasticity of substitution between composite labor and capital.

ρ_2 : elasticity of substitution between skilled labor composite and unskilled labor.

ρ_3 : elasticity of substitution between semi-skilled labor and skilled labor.

ρ_a : elasticity of substitution between domestic demand and imports.

ρ_a : elasticity of substitution between domestic sales and exports.

ε_{ex} : export demand elasticity

Source : Jung and Thorbecke (2003) and Chadha et al (1998) .

Table 4 : Resource endowment shares in percentages

	Non-educated Labor (Unskilled labor)	Secondary-educated Labor (Semi-skilled labor)	Higher-educated labor (Skilled-labor)	Physical Capital
RC	20.34	13.98	2.65	27.34
RATN	19.54	4.33	0.63	10.06
RAL	31.02	11.59	0.32	0.33
RO	14.69	21.68	9.45	2.61
UF	1.37	0.50	0.00	1.00
UNASE	2.59	8.86	8.79	14.16
US	6.64	33.30	75.73	6.18
UCL	3.25	5.02	0.90	1.53
UO	0.55	0.75	1.54	3.64
	100.00	100.00	100.00	66.86

Note : RC : Rural Cultivator ; RATN : Rural Artisan ; RAL : Rural Agricultural Laborer ; RO : Rural Others ; UF : Urban farmer ; UNASE : Urban Non-agricultural Self-employed ; US : Urban Salaried ; UCL : Urban Casual Laborer ; UO : Urban Others.

Physical capital endowment includes that of land. Capital column sums up to only 66.86% because the remaining 33.14% accrues to private enterprise, public enterprise, government and the rest of world.

Source : Calculations from Pradhan and Roy (2003), MIMAP India Survey Report,

Labor supply and wage levels

In the baseline scenario, labor supply grows annually at the rate of 1.84 percent (table 5). Among the three types of labor, the supply of higher educated workers grows fastest at the rate of 4.94 percent, followed by secondary-educated workers' supply which increase at the rate 3.66 percent. The supply of non-educated labor, which is determined residually, grows by only 1.04 percent annually. It would seem that the 6.31 percent and 7.34 percent annual growth in real public expenditure on secondary and higher education respectively is making a positive impact on the supply of educated workers.

Regarding wage levels, there is maximum improvement in the non-educated workers' wage rate which increases by 3.86 percent annually. Education expenditure benefits the non-educated labor indirectly, by inducing a relative decrease in its supply. Secondary-educated workers' wage rate also grows fast at 3.57 percent. The wage rate of higher-educated workers increases at only 3.07 percent per annum. The wage rates of secondary and higher educated workers rise despite the increase in their supplies because the techniques of production become more skill intensive as the economy grows over time (table 5).

Table 5 : Baseline : Labor supply, wage rates and public education expenditure

	Average annual growth rates for 2003-04 to 2029–30 in percent
Labor Supply	**1.84**
Non-educated labor	1.04
Secondary-educated labor	3.66
Higher-educated labor	4.94
Wage rate (real)	**4.55**
Non-educated labor	3.86
Secondary-educated labor	3.57
Higher-educated labor	3.07
Public education expenditure (real)	**8.47**
Secondary education	8.31
Higher education	9.34

Table 6 : Baseline : Wage rate indexes

	Wage rate as a multiple of non-educated worker's wage rate	
	2003-04	2029-30
Wage rate (real)		
Non-educated labor	1.00	1.00
Secondary-educated labor	1.98	1.95
Higher-educated labor	7.55	7.16

The higher rate of growth of the non-educated worker's wage notwithstanding, the wage inequality across the three types of labor – particularly between non-educated and higher-educated labor - remains acute at the end of the seven-year period (see table 6). This is mainly due to the extreme inequality of wages of the three types of labor prevailing at the beginning of the period.

GDP and household income

Real GDP in the base-run grows at 7.02 percent per annum, with investment in physical capital being on an average 28.35 percent of GDP. The rate of growth of wage income is 2.86 percent higher than that of the capital income (table 7).

Household income as a whole grows at 6.61 percent per annum. But the rates of growth of incomes vary widely across the various household groups. The rate of growth of incomes of the urban salaried (US) class is, expectedly, the highest – i.e., 8.26 percent. Urban salaried households are the greatest beneficiaries from the spread of education. These households account for 75.75 percent of the higher-educated and 33.30 percent of the secondary-educated labor (see table 4). Urban non-agricultural self-employed (UNASE) improve their incomes at the rate of 6.06 percent per annum. This class also depends largely for its income on secondary and higher-educated labor. Another group, not so expected, which benefits from the spread of education is rural others (RO). This group is endowed with 21.68 percent of the secondary–educated workforce and 9.45 percent of higher-educated workforce. However, the non-beneficiaries of education – i.e., those having mainly non-educated labor as a source of their income – are also significantly better-off, thanks to the rise in the wage rate of non-educated labor. For example, household incomes of the rural agricultural laborers (RAL) grow at 6.18 percent per annum. Urban casual laborers (UCL), who are to a large extent though not mainly dependent on non-educated labor, also increase their incomes by 6.43 percent per annum[3].

Table 7 : Baseline : GDP and household income

	Average annual growth rates for 2003-04 to 2029 –30 (in percent)
GDP (real)	**7.02**
Investment (% of GDP)	28.35
Wage Income (real)	7.69
Capital Income (real)	4.83
Household Income (real)	**6.61**
Rural Cultivator (RC)	5.50
Rural Artisan (RATN)	5.51
Rural Agricultural Labor (RAL)	6.18
Rural Others (RO)	7.11

[3] Note that wage income is allocated to each household group on the basis of the base-year endowment shares for all the years. That is, the flow of new labor types is distributed across household groups in the same way as the whole labor stock.

Urban Farmers (UF)	5.46
Urban Non-ag. Self-Employed (UNASE)	6.06
Urban Salaried (US)	8.61
Urban Casual Laborer (UCL)	6.43
Urban Others (UO)	5.68

THE POLICY SIMULATIONS

As is usually done in a CGE modeling analysis, after generating a base-line (business-as-usual) scenario, we simulate alternative policy scenarios for assessing the consequences for growth and income distribution in India of an expansion in public education expenditure. The specific policy questions to which the policy scenarios are addressed are the following :

(i) What is the impact of an increase in public education expenditure financed by an increase in direct taxes on GDP growth and income distribution ?

(ii) What is the impact of an increase in public education expenditure concentrated in the secondary education sector financed by an increase in direct taxes on GDP growth and distribution ?

(iii) What is the impact of an increase in public education expenditure concentrated in the secondary education sector complemented with an increase in public investment financed by an increase in direct taxes on GDP growth and distribution ?

We develop three alternative policy scenarios corresponding to the above three policy questions respectively. In all the three simulations, the increase in public education expenditure is financed by an increase in the direct taxes – i.e., income and corporate tax. In fact, the increase in public education expenditure is implemented in a manner suggested by Mehrotra (2004). That is, we increase the income and corporate taxes by a specified percentage and dedicate the resulting additional revenue to public spending on education. The mode of financing remains the same in all the three simulations, but the mode of expenditure varies across them. In the first simulation, the additional expenditure on education is distributed between secondary and higher education in the same proportions as in the total expenditure of the base-line scenario. In the second scenario, the extra expenditure is directed exclusively towards secondary education. In the third policy scenario, the additional revenue from the specified increase in tax rates is shared equally between investment in physical capital and education expenditure concentrated in the secondary education sector.

Before we delve into a quantitative assessment of the policy scenarios in comparison to the base line scenario, it would be useful to bear in mind how the model works out the impact of enhanced investments in physical capital and human capital on economic growth and its attendant income distribution.

The contribution of a factor input in a sector is essentially determined by its share parameter in the CES production function pertaining to that factor in that sector. In any given production nest, the factor with the higher share parameter contributes more to the output of that nest. For example, in the nested production structure, in the particular nest which captures the value-added by combining capital and composite labor, the share parameter of the latter is higher than that of the former in most sectors; hence, composite labor, as compared to capital, contributes more to GDP. Likewise, in subsequent lower nests, the share parameter of skilled labor composite is higher than that of unskilled labor in most sectors, which implies that the former's contribution to GDP is more than the latter, and the share parameter of the secondary-educated labor is higher than that of higher-educated labor in all sectors except 'education' and 'other services' indicating the larger contribution of former *vis-a-vis* the latter.

It follows that, in the nested production structure, with its above constellation of share parameters, there would result less value addition through investment in physical capital *vis-à-vis* investment in human capital. This is because the former works by increasing the supply of physical capital resulting in a higher value of physical capital whose share parameter is lower than that of composite labor. Conversely, the latter works by increasing the supply of educated labor, leading, in turn, to a higher value for composite labor, whose share parameter is higher than that of physical capital. Hence, investment in human capital would cause a larger accretion in GDP (at factor cost) as compared to equivalent investment in physical capital. The downturn, however, for the policy of enhanced human capital investment is that the larger GDP gains come after a time lag associated with educational investment – i.e., when the potential worker departs from the unskilled (non-educated) labor force pool to spend some time in the educational pipeline before entering the pool of semi-skilled (secondary-educated) or skilled (higher-educated) labor as the case maybe.

How equalizing or disequalizing is the impact of an increase in investment in education *vis-a-vis* increase in physical capital investment ? Increasing physical capital investment would create a demand-generating effect as well as a supply-augmenting effect for capital goods, of which the former is likely to be stronger leading to a rise the return on capital. Moreover, more demand for capital will enhance the demand for composite labor as they are complementary inputs (i.e., elasticity of substitution between capital and composite labor in the value-added nest is less than one). Rise in demand for composite labor will translate into an increase in demand for all the three types of labor – with the increase in demand for skilled labor and semi-skilled labor being relatively more than that for unskilled labor. Consequently, wages for skilled labor and semi-skilled labor will rise more than unskilled laborers' wage. Wage inequality across the four factors of production – labor of three skill types and capital – would, therefore, rise .Since, wage disparity and personal income or household income inequality are almost monotonically related in the model, personal income inequality would rise too. That is to say, growth engendered by enhancing investment in physical capital is potentially mildly disequalizing.

Enhancing investment in education leads to an increase in both demand and supply of secondary-educated and higher-educated labor. However, the demand-generating effect is stronger than the supply-augmenting effect. Hence, wages rise for secondary-educated labor and higher-educated labor. As the structure of production shifts towards skill-intensive sectors ('education' and 'other services'), there is a relative decline in demand for non-educated labor, However, with more and more people choosing to educate themselves, the residual supply of non-educated labor reduces. So much so that the wage rate of non-educated labor rises too. The return on capital remains more or less unaffected. It follows that, the wage inequality across the three labor types would most likely alleviate, and so would the personal income inequality because of the monotonic relationship between it and the wage inequality. Clearly, then, with increased investment in education, the resulting growth is likely to be more equalizing.

Policy simulation 1

In this simulation, we increase the rates of income tax and corporate tax by 10 percent and use the additional revenue for increased public spending on secondary and higher education in the same proportions as in total public education expenditure of the base-run. By this mechanism, the 10 percent increase in the two direct tax rates, results in a 14.40 percent increase in real public education expenditure over the base-run. And public education expenditure as a percentage of GDP, increases by 0.43 percentage point compared to the base-run.

Table 8 : Simulation 1 : Labor supply and wage rates

	Average annual growth rates for 2003-04 to 2029–30 (in percent)		Diff.from base-line in %age points
	Simulation 1	Baseline	Simulation 1
Labor Supply	**1.84**	**1.84**	**0.00**
Non-educated labor	0.61	1.04	-0.43
Secondary-educated labor	4.01	3.66	0.35
Higher-educated labor	5.26	4.94	0.32
Wage rate (real)	**4.57**	**4.55**	**0.02**
Non-educated labor	5.13	3.86	1.27
Secondary-educated labor	3.02	3.57	-0.55
Higher-educated labor	2.57	3.07	-0.50

In policy scenario 1, the growth rate of secondary and higher educated labor supply goes up by 0.35 and 0.32 percentage points respectively, but that of the non-educated labor supply goes down by 0.43 percentage point, since it is determined residually. As a result non-educated workers become relatively scarce and improve the growth rate of their wage rate by 1.27 percentage points. The secondary and higher educated workers are supplied more abundantly and, therefore, suffer a decline in the growth rates of their wage rates by 0.55 and 0.50 percentage points respectively (table 8). The inequality in the wages also narrows down a little, with the higher and secondary educated workers receiving wages which are respectively 6.35 times and 1.73 times the wage of the non-educated workers (table 9).

Table 9 : Simulation 1 : Wage rate indexes

	Wage rate as a multiple of non-educated worker's wage rate in 2029-30	
	Simulation 1	Baseline
Wage rate (real)		
Non-educated labor	1.00	1.00
Secondary-educated labor	1.73	1.95
Higher-educated labor	6.35	7.16

With a 14.40 percent increase in public education expenditure, GDP growth rate improves by 0.20 percentage point. Investment as a percentage of GDP declines marginally, since its level is fixed exogenously and remains the same as in the base-run. As a result, capital, in comparison to educated labor whose supply increases, becomes scarcer. Hence, capital income growth rate increases by almost twice as many percentage points as the increase in the wage income growth rate (table 10). Household income also grows faster by 0.15 percentage point. An inter-group comparison of the household income growth rates reveals that all groups experience a faster growth in their incomes except, the urban salaried (US) and the rural others (RO), who suffer a decline in their income growth rates as a consequence of the fall in growth rates of wages of secondary-educated and higher-educated workers. It may be noted that these two groups are the ones experiencing the highest growth rates in their incomes in the business-as-usual scenario. Hence, a decline in their income growth rates in the face of a rise in the income growth rates of the remaining groups represents a distinct change towards greater equalization of incomes.

Table 10 : Simulation 1 : GDP and household income

	Average annual growth rates for 2003-04 to 2029–30 (in percent)		Diff. from base-line in %age points
	Simulation 1	Baseline	Simulation 1
GDP (real)	**7.22**	**7.02**	**0.20**
Investment (% of GDP)	27.65	28.35	-0.70
Wage Income (real)	7.77	7.69	0.08
Capital Income (real)	4.98	4.83	0.15
Household Income (real)	**6.76**	**6.61**	**0.15**
Rural Cultivator (RC)	5.72	5.50	0.22
Rural Artisan (RATN)	5.68	5.51	0.17
Rural Agricultural Labor (RAL)	6.40	6.18	0.22
Rural Others (RO)	7.01	7.11	-0.10
Urban Farmers (UF)	5.45	5.46	-0.01
Urban Non-ag. Self-Employed (UNASE)	6.14	6.06	0.08
Urban Salaried (US)	8.48	8.61	-0.13
Urban Casual Laborer (UCL)	6.54	6.43	0.11
Urban Others (UO)	5.95	5.68	0.27

Note : The fast movers – i.e., those household groups having income growth rates higher than 7% in the base-line - are shown in italics.

Policy simulation 2

In this simulation, we increase the rates of income tax and corporate tax by 10 percent and use the additional revenue for increased public spending exclusively on secondary education. By this mechanism, the 10 percent increase in the two direct tax rates, results in a 17.53 percent increase in real public expenditure on secondary education over the base-run. For public expenditure on education as whole the increase is of 14.47 percent. As a percentage of GDP, the increase in expenditure on elementary education is by 0.41 percentage point.

In policy scenario 2, supply of secondary-educated labor goes up while that of non-educated labor goes down like in simulation 1. But the order of magnitudes involved are higher in case of this simulation. In comparison to the base-run, the rate of growth of supply of secondary-educated labor increases by 0.52 percentage point, while that of non-educated labor declines by 0.48 percentage point. The growth rate of higher-educated workers also declines marginally. The improvement in the wages of the non-educated labor is, as compared to the base-run, much faster. That is, the rate of growth in their wages is 5.18 percent, whereas it was only 3.86 percent in the base-run. For secondary-educated labor, which is now more abundantly supplied, there is a fall in the growth rate of wages. It may be noted that in this scenario, there is a significant substitution in production in favor of secondary-educated labor *vis-à-vis* higher-educated labor. And this explains why there is a marginal *decline* in the growth rate of the higher-educated worker's wage even as higher-educated labor becomes relatively scarce. The wage rate inequality shows some improvement as the rate of growth of non-educated labor rises and that of the secondary-educated labor falls, but the higher-educated labor still earns a wage which is more than 6.5 times that of non-educated labor (table 12).

Table 11 : Simulation 2 : Labor supply and wage rates

	Average annual growth rates for 2003-04 to 2029 –30 (in percent)		Diff. from base-line in %age points
	Simulation 2	Baseline	Simulation 2
Labor Supply	**1.84**	**1.84**	**0.00**
Non-educated labor	0.56	1.04	-0.48
Secondary-educated labor	4.19	3.66	0.52
Higher-educated labor	4.89	4.94	-0.05
Wage rate (real)	**4.62**	**4.55**	**0.07**
Non-educated labor	5.18	3.86	1.32
Secondary-educated labor	3.08	3.57	-0.49
Higher-educated labor	3.03	3.07	-0.04

Continued…

Table 12 : Simulation 2 : Wage rate indexes

	Wage rate as a multiple of non-educated worker's wage rate in 2029-30	
	Simulation 2	Baseline
Wage rate (real)		
Non-educated labor	1.00	1.00
Secondary-educated labor	1.70	1.95
Higher-educated labor	6.52	7.16

Table 13 : Simulation 2 : GDP and household income

	Average annual growth rates for 2003-04 to to 2029 –30 (in percent)		Diff. from base-line in %age points
	Simulation 2	Baseline	Simulation 2
GDP (real)	**7.29**	**7.02**	**0.27**
Investment (% of GDP)	27.54	28.35	-0.81
Wage Income (real)	7.81	7.69	0.12
Capital Income (real)	5.03	4.83	0.20
Household Income (real)	**6.83**	**6.61**	**0.22**
Rural Cultivator (RA)	5.78	5.50	0.28
Rural Artisan (RATN)	5.73	5.51	0.22
Rural Agricultural Labor (RAL)	6.54	6.18	0.36
Rural Others (*RO*)	*7.14*	*7.11*	*0.03*
Urban Farmers (UF)	5.45	5.46	-0.01
Urban Non-ag. Self-Employed (UNASE)	6.22	6.06	0.16
Urban Salaried (*US*)	*8.57*	*8.61*	*-0.04*
Urban Casual Laborer (UCL)	6.61	6.43	0.18
Urban Others (UO)	6.00	5.68	0.32

Note : The fast movers – i.e., those household groups having income growth rates higher than 7% in the base-line - are shown in italics.

With a 17.50 percent increase in public expenditure on secondary education, GDP growth rate improves by 0.27 percentage point. An increase in the supply of secondary-educated labor (notwithstanding the marginal decline in the supply of higher educated labor), in our labor aggregation scheme, leads to a higher value for composite labor, resulting in higher value-added and, thus, higher GDP. Note that in this simulation, as compared to simulation 1, the GDP growth rate is higher, which suggests that the negative impact on productivity due to the decline in the growth rate of higher-educated workers is more than compensated by the positive impact on productivity on account of the rise in the growth of secondary-educated workers. However, this by no means indicates the relative unimportance of higher education. On the contrary, a large-scale substitution of secondary-educated workers for higher-educated workers will, in all likelihood, result in a net loss of productivity for the economy. Hence, promoting secondary-education at the cost of higher education beyond a point may well be detrimental to GDP. In fact, the result of this simulation can easily reverse in a longer time frame or for a larger diversion of resources from higher to secondary education within the same time frame.

Household income as a whole grows at 6.83 percent per annum – which is faster than its rate of growth in the base-run by 0.22 percentage point. Except for the urban salaried (US) households, all households benefit from the faster spread of education under scenario 2. For the urban salaried (US) and urban farmers (UF) groups, the income growth rates marginally decline ; for all other groups the growth rates of income are higher (table 13). Urban salaried (US) group is hugely dependent upon higher and secondary educated labor for its incomes (see table 4). For higher-educated workers the growth rates of their wage rate as well as the labor supply decline in this simulation, while, for, secondary-educated workers the faster growth in labor supply is more than compensated by the slower growth in their wage rate. Hence, a decline in the income growth rate of the urban salaried (US) households. But the decline in the income growth rate of this group is only marginal – by 0.04 percentage point, and even after the decline its income growth rate is 8.57 percent. All other household groups improve their positions. Especially those groups which had income growth rates of less than 6 percent, such as, rural cultivator (RC) and rural artisan (RATN), have moved up to income growth rates near 6 percent. In short, the fast movers are slowing down and the slow movers are catching up. Income distribution thus changes for the better when the growth of secondary education is speeded up.

Policy simulation 3

In this simulation, we increase the rates of income tax and corporate tax by 10 percent, and the additional revenue is shared equally between investment in physical capital and education expenditure concentrated in the secondary education sector. This results in 8.55 percent increase in real public expenditure on secondary education over the base-run. For public expenditure on education as whole the increase is of 7.25 percent. As a percentage of GDP, the increase in expenditure on secondary education is by 0.22 percentage point. On the other hand, the additional investment in physical capital raises the investment-GDP ratio from 28.35 percent to 28.65 percent.

Under this scenario, the increase in expenditure on secondary education is smaller in comparison with that in the previous simulation. Hence, the growth in the supply of secondary-educated workers increases by only 0.20 percentage point (table 14). The decrease in the growth of residually determined non-educated labor supply is also of a lower order. The growth rate of higher-educated labor supply, however, picks up in this simulation, even though the expenditure on higher education does not increase. The growth in higher-educated labor supply is stimulated by the rise in the wages of this type of labor[4]. The growth in wage rates, in this simulation, increases not only for non-educated labor but for secondary and higher-educated workers as well. The reason for this is that the production techniques under this scenario become more skill intensive, thus increasing the demand for skilled labor – i.e., secondary and higher educated labor. It may be noted that the wage rates for secondary and higher educated labor grow faster in

[4] Note that the new labor supply at any level is influenced not only by the government expenditure on that level of education but also by the wage differential between the given level and the preceding level.

this simulation *vis-à-vis* the previous simulation. Finally, the wage-rate inequality in this simulation is the same as that in the base run. And in comparison to the previous simulation the wage inequality has worsened.

Table 14 : Simulation 3 : Labor supply and wage rates

	Average annual growth rates for 2003-04 to 2029 –30 (in percent)		Diff. from base-line in %age points	
	Simulation 3	Baseline	Simulation 3	Simulation 2
Labor Supply	**1.84**	**1.84**	**0.00**	**0.00**
Non-educated labor	0.81	1.04	-0.23	-0.48
Secondary-educated labor	3.86	3.66	0.20	0.52
Higher-educated labor	4.98	4.94	0.04	-0.05
Wage rate (real)	**4.71**	**4.55**	**0.16**	**0.07**
Non-educated labor	4.17	3.86	0.31	1.32
Secondary-educated labor	3.75	3.57	0.18	-0.49
Higher-educated labor	3.29	3.07	0.22	-0.04

Table 15 : Simulation 3 : Wage rate indexes

	Wage rate as a multiple of non-educated worker's wage rate in 2029-30		
	Simulation 3	Baseline	Simulation 2
Wage rate (real)			
Non-educated labor	1.00	1.00	1.00
Secondary-educated labor	1.92	1.95	1.70
Higher-educated labor	7.11	7.16	6.52

Table 16 : Simulation 3 : GDP and household income

	Average annual growth rates for 2003-04 to 2029–30 (in percent)		Diff.from base-line in %age points	
	Simulation 3	Baseline	Simulation 3	Simulation 2
GDP (real)	**7.45**	**7.02**	**0.43**	**0.27**
Investment (% of GDP)	28.65	28.35	0.30	-0.81
Wage Income (real)	7.87	7.69	0.18	0.12
Capital Income (real)	5.12	4.83	0.29	0.20

Continued...

Household Income (real)	**6.96**	**6.61**	**0.35**	**0.22**
Rural Cultivator (RC)	5.68	5.50	0.18	0.28
Rural Artisan (RATN)	5.65	5.51	0.14	0.22
Rural Agricultural Labor (RAL)	6.42	6.18	0.24	0.36
Rural Others (*RO*)	*7.32*	*7.11*	*0.21*	*0.03*
Urban Farmers (UF)	5.44	5.46	-0.02	-0.01
Urban Non-ag. Self-Employed (UNASE)	6.35	6.06	0.29	0.16
Urban Salaried (*US*)	*8.71*	*8.61*	*0.10*	*-0.04*
Urban Casual Laborer (UCL)	6.54	6.43	0.11	0.18
Urban Others (UO)	6.13	5.68	0.45	0.32

Note : The fast movers – i.e., those household groups having income growth rates higher than 7% in the base-line - are shown in italics.

Under scenario 3, in which there is a simultaneous increase in investment in physical capital and expenditure on secondary education, the real GDP growth rate goes up by 0.43 percentage points - which is 0.16 percentage point more than the increment in real GDP growth rate under scenario 2. (Recall that in scenario 2, the additional resources raised from the increase in the income and corporate tax rates is spent completely and exclusively on secondary education). It follows that when an increase in expenditure on secondary education is matched with an increase in investment in physical capital, the growth in labor productivity and thus real GDP is enhanced. Household income as a whole is also growing faster in this simulation as compared to simulation 2. However, an inter-group comparison of the household income growth rates of this simulation *vis-à-vis* the previous simulation shows that the income distribution is tending to become more unequal. That is, the fast movers among the household groups, such as, urban salaried (US) and rural others (RO) are moving up the income ladder faster, while, the slow movers – rural cultivator (RC), rural artisan (RATN), rural agricultural labor (RAL) and urban casual laborer (UCL) - are inching up even more slowly.

Policy simulations – caveats

In the interpretation of the simulation results, the assumptions on which our model is based must be borne in mind. First, we assume that increased public education expenditure will translate into improved educational outcomes. However, the efficiency of public education expenditure varies across states and on an average tends to be rather low (Pradhan and Singh (2004); Pradhan, Tripathy and Rajan (2000)) . The low efficiency of public education expenditure in many states will bring down the "average" efficiency of such expenditure, which we have tried to capture in the model by assigning "low" values for the elasticities of the output flow of educated labor with respect to public education expenditure. Second, we assume that the technology and the resource endowment shares of different household groups are fixed during the time span of our model.

This is justifiable for the fairly moderate policy changes considered in our simulations. Third, we assume that the labor markets for the three types of labor are segmented. In the real world, it may be possible that higher-educated workers enter the market for secondary-educated workers and secondary-educated workers enter the market for non-educated workers, if they are unsuccessful in finding a job of their respective skill (educational) level. However, the magnitudes of these reverse flows of educated labor are not likely to be large especially because the initial wage rates of the three types of labor are far apart from each other and do not converge very much in the time frame of our model. In other words, this assumption is not as restrictive as it seems

CONCLUSIONS AND POLICY IMPLICATIONS

We conclude by highlighting the main policy lessons from our simulation exercises. The policy lessons that emanate from our policy scenarios are mainly three.

In policy scenario 1 we observed that a 14 percent increase in real public expenditure on secondary and higher education, financed through a 10 percent increase in the income and corporate tax rates, helps in achieving higher economic growth as well as an improved income distribution. However, it may be noted that the improvement in both real GDP growth and income distribution is a moderate one. An interesting aspect of the result is that the non-educated workers also benefit from the spread of education. There is a marked rise in the wage rate of these workers, which is instrumental in reducing the wage inequality. The policy implication of this scenario is that it is possible to augment investment in human capital in the resource constrained fiscal environment of the Indian economy and reap the benefits in terms of a faster economic growth and a better income distribution.

In policy scenario 2, there is 17.5 percent increase in real public expenditure on secondary education (financed in the same way as in scenario 1) and the base run level maintained for public expenditure on higher education. As a result, both the real GDP growth and the improvement in income distribution is enhanced. Real GDP growth in this scenario is not only more than that in the baseline scenario, but also exceeds the real GDP growth achieved in scenario 1. Similarly, income distribution in this scenario is even better than that of scenario 1. Hence, this scenario does indicate that, from a policy point of view, secondary education needs to be accorded higher priority. However, it does not follow that secondary education should be promoted at the cost of higher education. In comparison to scenario 1, there is in scenario 2 an increase in the supply of semi-skilled labor along with a decrease in the supply of skilled labor. The resulting net impact of such a trade-off on composite labor and ultimately on GDP is favorable in the medium term but may well turn unfavorable to real GDP growth in the long-term. Moreover, the model, in its current form, does not incorporate other benefits of higher education, such as, facilitation of innovation which can significantly boost GDP. Hence, limiting the growth of higher educated labor would eventually limit the growth of labor productivity and thus of real GDP. On balance the policy conclusion which follows is that efforts need to be directed and intensified towards finding alternative means of financing higher education (such as from the private sector) so that more resources are available for expanding secondary education.

In policy scenario 3, there is a judicious mix of investment in physical capital and investment human capital. The mobilization of resources is done similarly, but the spending of the additional resources is spread equally over investment in physical capital and expenditure on secondary education. In comparison to scenario 2, the productivity gains are larger in this scenario, and real GDP growth is further enhanced. But the wage inequality and the household income distribution clearly worsen in comparison to scenario 2. This result in combination with the result of the previous simulation indicates, on the one hand, that investment in physical capital is essential for easing the constraints on productivity growth, and, on the other hand, that investment in human capital plays a crucial role in spreading the benefits of economic growth more evenly across the various sections of the population. The policy lesson that we would like to draw from this is that government should preoccupy itself with the task of expanding the human capital base, and, at the same time, encourage the private sector to accelerate investment in physical capital. This is now a widely accepted view. It is also endorsed by our simulation results.

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