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Demographic Transition, Education, and Inequality in India

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Abstract

India is entering demographic transition much later than most developing countries, and will still be a relatively young nation twenty years from now. As the population ages and younger, better-educated cohorts enter the workforce. While the shift in labor supply composition towards skilled labor is likely to have positive effects on overall productivity, the evolution of returns to skills – and, consequently, inequality – will depend critically on changes in demand for these workers. To address these questions in a consistent framework, this paper links a computable general equilibrium (CGE) model of India with household survey data from India's National Sample Survey Organization (NSSO) in a simple micro-simulation framework. The CGE model results demonstrate that the demographic transition and the rising share of skilled workers could have substantial growth benefits for the Indian economy, raising the average per capita GDP growth over the 2011-2030 period by nearly 0.5 percentage points with most of the benefit coming from increasing skills rather than the rising worker/population ratio.

Keywords: Demographic transition, inequality, India

JEL classification:

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1. Introduction and motivation

India is entering demographic transition much later than most developing countries, and will still be a relatively young nation twenty years from now. As the population ages and younger, better-educated cohorts enter the workforce, the average schooling of the working age population will increase by at least a full year even with no further improvements in the educational attainment of today's youth and could rise much faster if further progress is achieved on the education agenda.

While the shift in labor supply composition towards skilled labor is likely to have positive effects on overall productivity, the evolution of returns to skills – and, consequently, inequality – will depend critically on changes in demand for these workers. A growing number of analysts have questioned whether the supply and quality of jobs will be sufficient for the new workforce entrants to take advantage of the demographic dividend (see, for example, Government of India Economic Survey, 2013). While the supply effect can be largely thought of as exogenous – driven by expected demographic trends and the observed differences between the educational attainments of the young and the old – the ability of the economy to absorb the rising share of skilled workers will depend on the speed as well as sectoral pattern of economic growth. Furthermore, the evolution of returns to skilled labor – as an outcome of the supply and demand interactions – will determine the evolution of inequality and the shape of India's income distribution.

To address these questions in a consistent framework, this paper links a computable general equilibrium (CGE) model of India with household survey data from India's National Sample Survey Organization (NSSO) in a simple micro-simulation framework. The recursive-dynamic CGE model has a 2011 base year (corresponding to Indian FY2011/12), seven broad categories of economic activity with varying skill intensities, and three factors of production (unskilled labor, skilled labor, and capital). The sectoral distribution of employment and labor value added has been reconciled, to the extent possible, with the 2011/12 round of India's NSSO household survey. The CGE model is then solved recursively until 2030, using the World Bank's most recent medium-term macroeconomic forecast to calibrate labor productivity in the baseline. Changes in employment across the farm and non-farm sectors, labor earnings by skill and agriculture/non-agriculture, relative price changes across food and non-food commodities, and growth in consumption per capita are then mapped to the household survey to produce a counterfactual distribution.

The paper analyzes the evolution of poverty and inequality between 2011 and 2030 under a baseline scenario which incorporates the expected aging dynamics and their impact on increased skill content of the labor force. The overall effects of on economic growth, allocation of resources across sectors, returns to labor, and inequality are then decomposed into contributions from aging and education with counterfactual scenarios. The remainder of the paper is organized as follows: section 2 describes the past trends of inequality in India and links the widening inequality to, *inter alia*, rising returns to skilled labor, section presents the model and data used in this paper, section 4 develops the scenarios and discusses the impacts of a rising share of skilled workers on macroeconomic, sectoral, and distributional variables, while section 5 offers some concluding remarks and directions for future research.

2. Recent trends in inequality

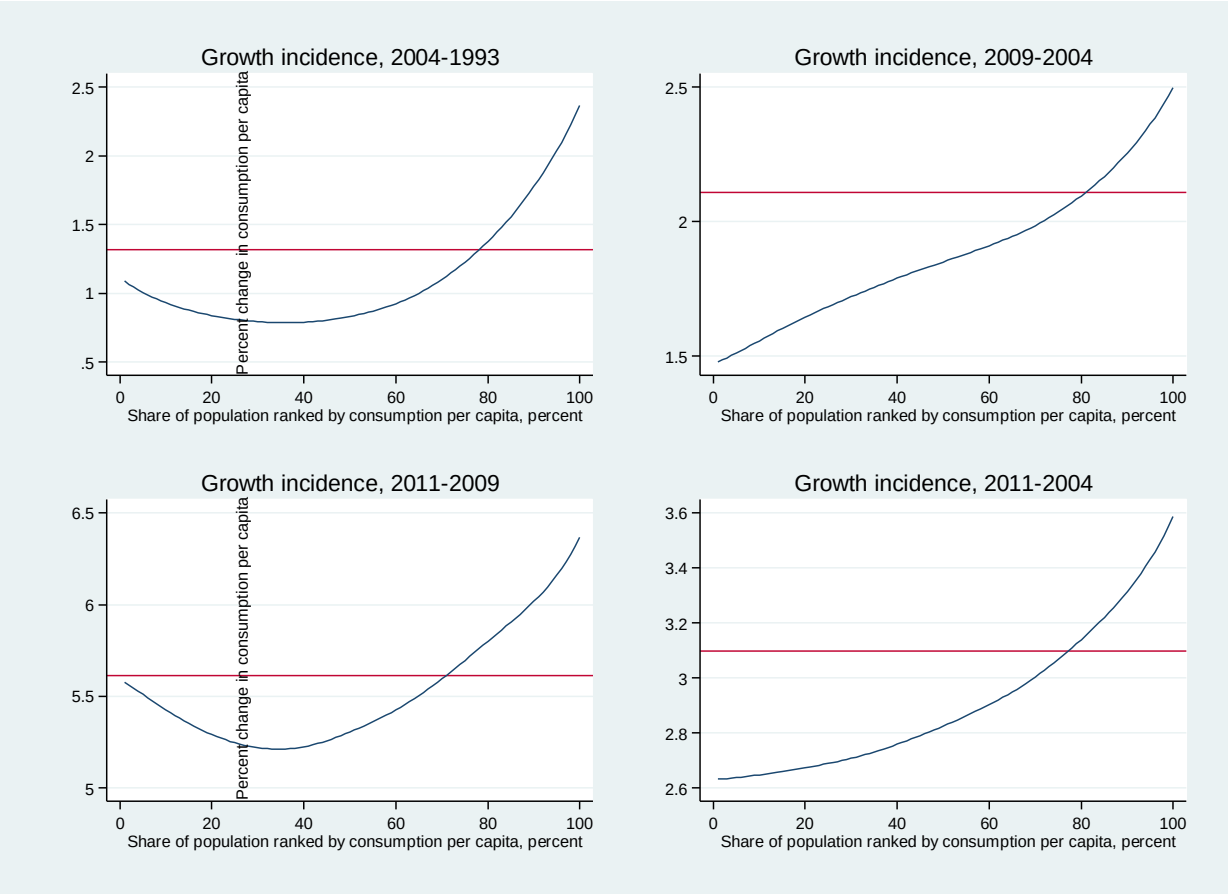
While over the past two decades India has enjoyed a period of high per capita GDP growth (average 5.3 percent per year) and major reductions in poverty (Table 1), inequality has also widened. The consumption Gini coefficient increased by nearly 5 points and the average consumption of the bottom 40 percent of the distribution has consistently lagged behind the rate of growth of the mean. Moreover, rates of per capita consumption growth have been consistently higher for richer percentiles of the population, resulting in widening inequality (Figure 1).

Table 1: Characteristics of India's income distribution (1993-2011)

	1993-94	2004-05	2009-10	2011-12	%Δ, 09-11	%Δ, 04-11
Household consumption per capita (2009 Rs.)	831.49	960.12	1,065.62	1,188.65	5.62	3.10
Household consumption per capita, bottom 40% (2009 Rs)	487.33	532.57	578.60	640.83	5.24	2.68
Poverty headcount, national poverty line	45.54	37.72	29.91	22.04	-3.93	-2.24
Poverty gap, national poverty line	11.19	8.37	6.20	4.03		
Gini	27.79	30.92	31.96	32.26		
Theil (GE[1])	15.13	18.76	20.89	21.00		

A large part of the increase in overall inequality can be attributed to the rising demand – and returns – for skilled labor. Defining skilled workers as those who have completed at least 12 years of education, returns to skills – defined as either individual labor earnings or per capita consumption of households where the head is a skilled worker – have risen more rapidly than remuneration of unskilled labor. Although Cain et. al. (2010) argue that whatever increases in education that have taken place up until 2004 have been more than enough to meet increased demand for education, technical and professional positions have seen an 18% increase in returns in urban areas. Some of this increased return to skilled labor may be due to skill biased technological change and foreign direct investment (Bang 2005), but also to increased inequality in educational opportunity (Asadullah 2012, Pal and Ghosh 2010). Overall, however, as inequality has widened between 1993/94 and 2011/12, dispersion between the two skilled groups has also increased. During the last decade (between 2004/05 and 2009/10), the growing gap between households headed by skilled and unskilled workers has accounted for the entire change in the Theil index.

Figure 1: Growth incidence (1993-2011)



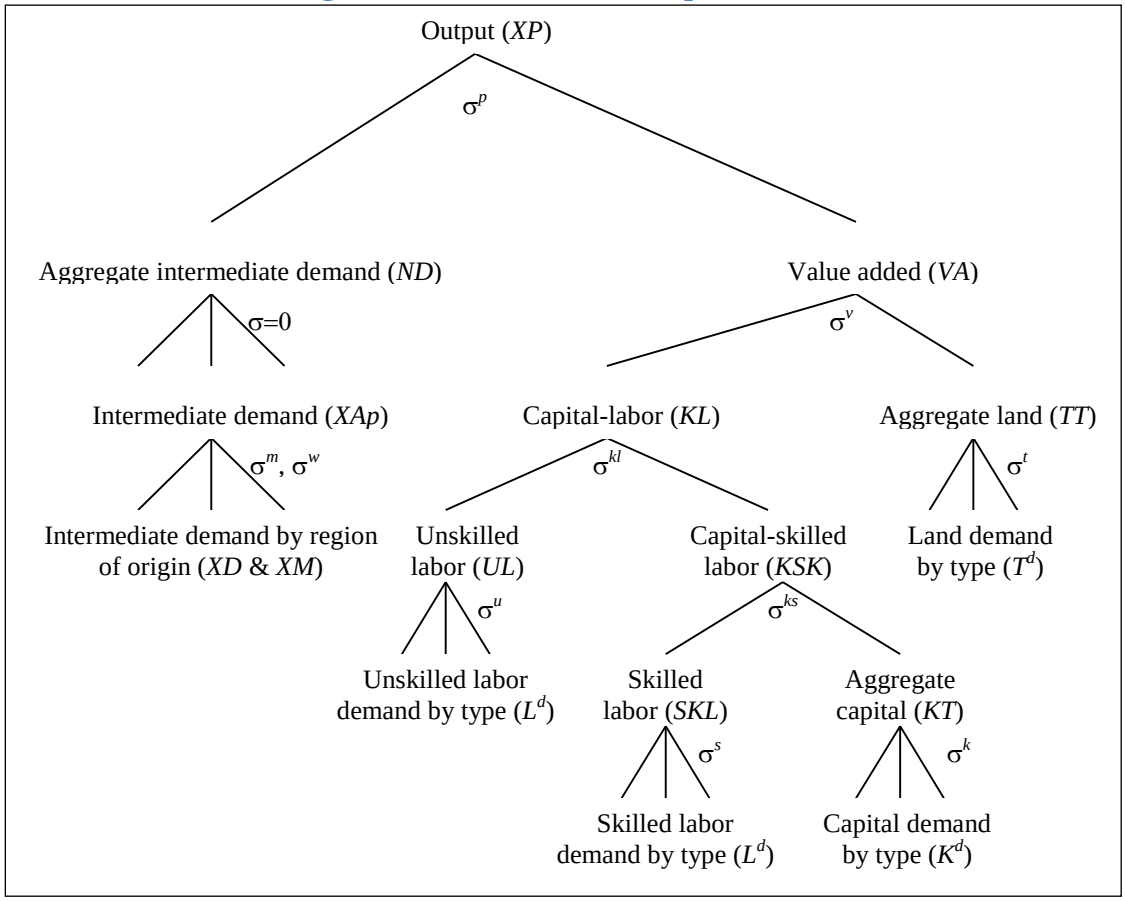
3. Model and data

The CGE model used in this paper is the World Bank's prototype single-country model.[1] Production takes place under perfect competition and constant returns to scale, and is modeled in a nested constant elasticity of substitution (CES) fashion to reflect various substitution possibilities across inputs (see Figure 2). All labor and capital income accrues to the households. Household demand is allocated across commodities according to the linear expenditure system (LES), in which consumers maximize a Stone-Geary utility function subject to the disposable income constraint.[2] Other final demand agents—government and investment—use the CES expenditure system.

International trade is modeled using the nested Armington specification, in which consumer products are differentiated by region of origin and combined using CES functions.[3] World import prices are fixed, which means that any increase in import demand can be satisfied without affecting global prices. On the supply side, producers allocate output to domestic and export markets the model according to a constant elasticity of transformation (CET) specification while the export price elasticity of demand is infinite.

[1] Detailed model documentation and the user's guide are available in van der Mensbrugghe (2005b) and van der Mensbrugghe (2005a), respectively.
[2] See Deaton and Muellbauer (1980, Chapter 3) for a detailed discussion of the LES demand system, and Stone (1954) for the Stone-Geary utility function.
[3] See Armington (1969).

Figure 2 Nested structure of production



The aggregate stock of capital is allocated across various sectors with a finite elasticity of transformation, resulting in imperfect mobility of capital. Skilled workers are freely mobile throughout the economy, while the market for unskilled labor is segmented into farm- and non-farm categories. Within each segment, labor is perfectly mobile across activities, but mobility across segments is limited by a migration function which responds to changes in the farm/non-farm wage premiums.

The volumes of government current and investment spending are fixed as shares of real GDP, while the deficit (in real terms) is also fixed. Public revenues adjust to clear the government balance by means of a flexible household direct tax rate.[4] The investment-to-GDP ratio is fixed at the base year value and a flexible marginal propensity to save out of household disposable income ensures that total saving equals total investment. The current account balance is fixed by the available quantity of foreign saving and the

[4] Although other assumptions about closing the government balance, such as adjustments in indirect taxes, increased borrowing, or reduced spending, are also plausible, choosing the direct tax rate as an instrument is a fairly neutral way (in an allocative sense) of restoring fiscal balance in case of a shock. It also simplifies welfare measurements since the incidence of making up the budgetary shortfall falls squarely on consumers (in contrast to indirect taxes, which, for example, may motivate producers to allocate a larger share of production toward exports which may be taxed at a lower rate).

exchange rate is the numeraire, which means that domestic prices are determined relative to a fixed-cost basket of foreign goods.[5]

The model is solved in a recursive dynamic mode, in which subsequent end-of-period equilibria are linked with a set of equations that update the main macro variables. There are three determinants of real GDP growth in the model: labor supply growth, capital accumulation, and increases in productivity. Labor volume growth is determined outside of the CGE model through the "pipeline" aging effect, under the assumption of constant labor force participation rates. The capital stock in each period is the sum of depreciated capital from the period before and new investment. For all sectors, capital productivity remains fixed throughout the model horizon, while growth in labor productivity in the business-as-usual (BaU) scenario is calibrated to real GDP growth in the World Bank's medium- and long-term forecast. In all other scenarios, labor productivity is fixed in each period at the BaU level, and GDP growth becomes endogenous.[6] Thus, real GDP growth may differ from BaU due to faster/slower accumulation of capital or shocks to the productivity shift parameters, allowing the variations in GDP growth across scenarios to be directly attributed to the shocks.

Distributional analysis is carried out with the World Bank's GIDD model, which generalizes the existing CGE-microsimulation methodologies and is described in detail in Bussolo, De Hoyos, and Medvedev (2010). Starting from the observed global distribution, the CGE model provides a set of link variables for the micro-simulation: (a) change in the allocation of workers across sectors in the economy, (b) change in returns to labor by skill and occupation, (c) change in the relative price of food and non-food consumption baskets, and (d) overall growth in real consumption per capita. The final distribution is obtained by applying the changes in these link variables to the household survey.

4. Potential future trends in inequality

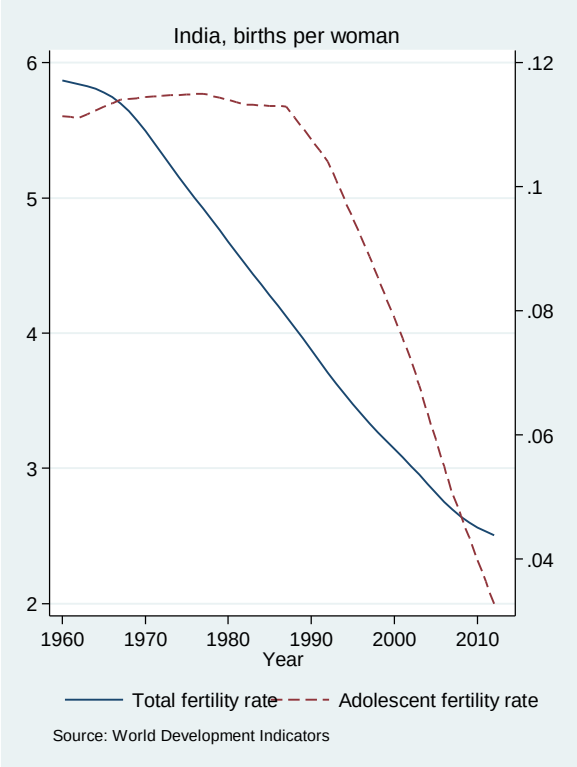
4.1 Demographic projections: how much will the age and education structure change?

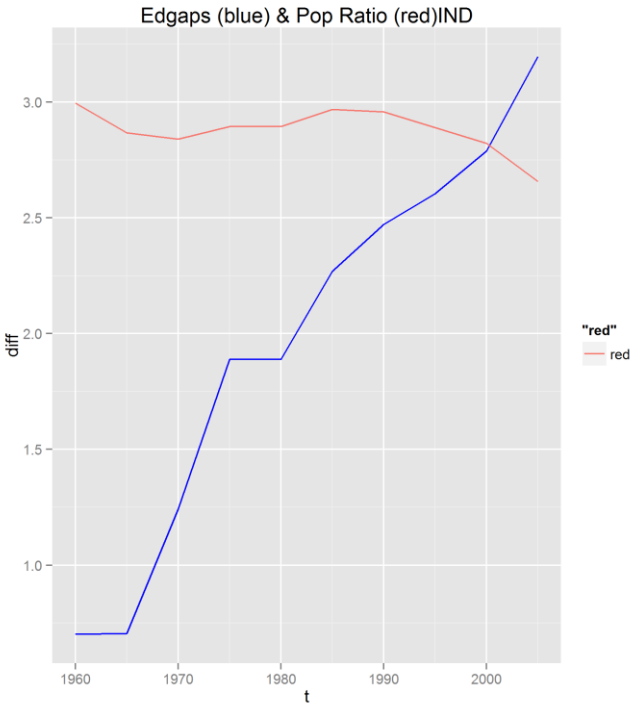
Expected demographic changes – in particular, forthcoming changes in age structure combined with increased levels of education of the younger cohorts – imply that, for India, a large wave of educated individuals will enter the labor market over the next two decades. Since these young cohorts replace older less educated (and also smaller) cohorts, the average education in India is likely rise by at least one year without any further effort to increase educational attainment among the current student-age population.

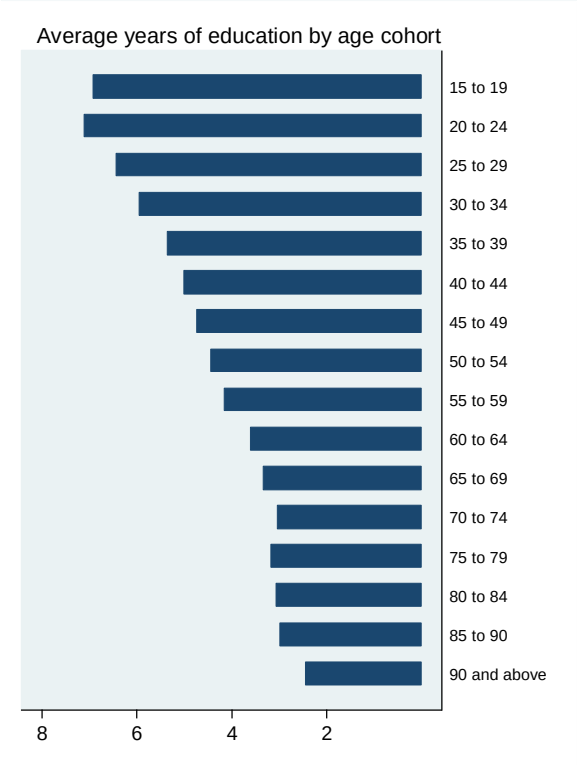
Consider first the current structure of India's population. As fertility rates came down while health outcomes and life expectancy improved since the middle of the last century, the ratio of young workers (aged 25-29) to older workers (aged 60-64) has come down (red line in the top right panel of Figure 3). Nonetheless, India remains a very young country today, with half of its population below the age of 24 (bottom right panel of Figure 3). Perhaps even more importantly, young cohorts continue to be much more educated than the older cohorts they gradually replace in the labor force. The ratio of the average years of education of young workers to that of older workers has risen dramatically over time (blue line in the top right panel of Figure 3) and today, the young workers have on average nearly three more years of education than older workers (bottom left panel of Figure 3).

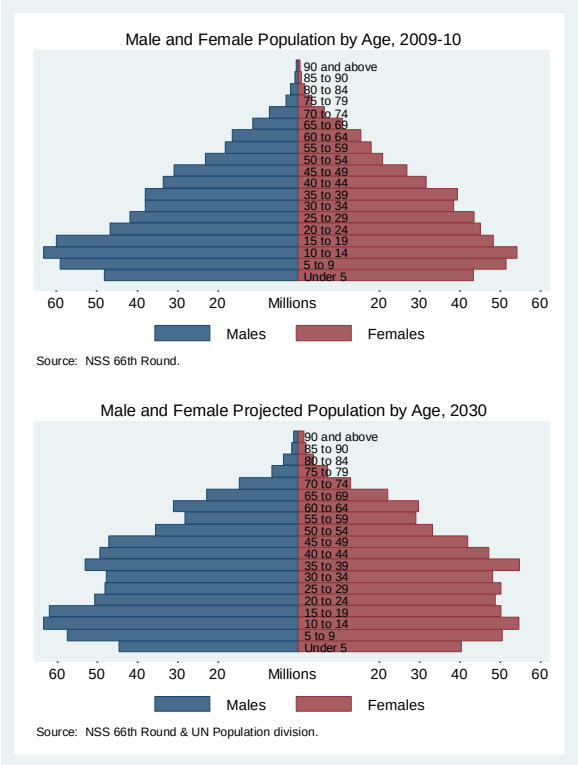
[5] We use the deflator of GDP at factor cost as a measure of movements in the real exchange rate.
[6] Thus, in the absence of any shocks, the BaU GDP growth rate is reproduced exactly.

Figure 3: Demographics and education









Extending these trends into the future by following the movements of age cohorts through time to match the UN population projections, we develop a new age-education structure of India's population in 2030 (Table 2). This new structure is generated via a "pipeline" effect where today's younger cohorts replace older cohorts of tomorrow, such that the 20-24-year-olds of 2010 become the 40-44-year-olds of 2030, carrying with them all of their characteristics (education, sector of employment, etc.). Younger cohorts, such as those currently in school or not yet born, take on the educational and other characteristics of today's young workers. In this sense, the increase in average educational attainment of the population is "passive" since we make no assumptions about further investments in the education of today's students which would otherwise result in even faster accumulation of skilled workers in the population.

Table 2: Education shock

Percent of group with tertiary education			
	2010	2030	Change
Young	0.2	0.7	0.5
Middle	0.9	1.1	0.3
Old	0.1	0.3	0.2
Percentage of population by education levels			
	2010	2030	Change
Prim	64.0	55.8	-8.3
Sec	34.5	41.7	7.1
Ter	1.4	2.5	1.1
AveEdu[1]	1.37	1.47	

Notes: 1. Average education is the weighted education level (primary=1, sec=2, tertiary=3) where the weights are equal to the population shares.

In modeling terms, the new 2030 population structure is arrived at by applying a re-weighting procedure to the 2011/12 India household survey: household sampling weights are adjusted such that greater weight is given to households with older and more educated members until the new age-education for the population are reached (see Bussolo, De Hoyos, and Medvedev, 2010, for details). Since the re-weighting procedure replicates all of the characteristics of today's older and more skilled households, it also changes the structure of the 2011/12 distribution in a number of other important ways. For example, households with a larger number of older and more skilled members are more likely to be found in urban areas, with their members more likely to be earning most of their income from non-agricultural activities. Because of this, these households also tend to have higher per capita consumption than households which are assigned lower weights as a result of the re-weighting procedure – with the end result being that the new 2030 age-education population is also characterized by a more urban, more non-farm, and more unequal distribution. The simulation steps described in section 4.3 below take into account most of these "by-products" of population aging when passing the economic shocks from the macro model to the initial distribution to generate a proper counterfactual.

4.2 Demand pressures (CGE model results)

As described in the previous section, the contribution of more skilled cohorts to India's labor force is likely to increase substantially over the next two decades. The impact of the increased supply of skilled labor on the returns to education, or the skill premium, will in turn depend on demand for skills, i.e. the

ability of the economy to generate jobs which require higher skilled workers.[7] Modeling the labor demand side presents a series of challenges, as it depends (mainly) on technological changes and on patterns of growth. For example, export led growth may have quite different labor market consequences if exports are concentrated in a few commodities or are supplied by broader manufacturing and service sectors. Changes in the premium may also be affected by shifts in the institutional setting and policies of the labor market, although these are outside the scope of the current paper.

In the CGE model of this paper, demand for skilled workers is generated solely through the process of economic growth. Faster rates of growth generate demand for higher-income-elasticity goods and services, which tend to require a more skill-intensive mix to produce. At the top level of the capital-labor nest, skilled labor and capital are also treated as complements, so that a faster-growing economy which accumulates savings and capital more rapidly will also demand larger quantities of skilled labor. The strength of these effects in generating a "sufficient" demand for skills depends on the rate of per capita GDP growth (which for India averages 5.3 percent per year through 2030 in the baseline scenario) and the share of high-income-elasticity goods and services in the households' consumption basket (which for India is just over 50 percent).

In order to evaluate the potential impacts of supply and demand-side factors on returns to skills, this section contrasts the baseline (BaU) scenario with two alternatives which decompose the effects of aging and education. The business-as-usual (BAU) scenario models the impacts of the demographic trends described earlier, i.e., a substantial aging of the population (the share of young people declines from 42 to 35 percent of the population) and a significant increase in skill intensity (the share of individuals with at least a secondary degree rises from 37 to 46 percent of the population, while the share of those with a tertiary degree increases from 1.6 to 2.8 percent). In the first alternative scenario (NoSkill), we isolate the impact of population aging from rising educational attainments by having the supply of both skilled and unskilled workers grow at the same rate, equal to the growth rate of the labor force. Effectively, this scenario illustrates the impact of the "pure" demographic dividend, as if the new larger labor force in 2030 retained the skill composition of today. A second alternative scenario (Demogr) develops a case where the economy benefits neither from rising skill attainments nor from the demographic dividend (i.e., the rising ratio of the labor force to population). In this scenario, the supply of skilled and unskilled workers grows at the same rate as total population (vs. growing at the rate of the 15-64 age group in the previous scenario).

Table 3 shows the path of the main macroeconomic variables in the three scenarios. Since the growth of total factor productivity is the same in all three scenarios, the differences across them can be attributed directly to differences in labor force growth (across skill categories) and the dynamic effects of faster employment growth and higher skill content on income levels, savings, capital accumulation, and subsequent growth. As mentioned earlier, real GDP per capita grows at an average annual rate of 5.3 percent in the BaU scenario, where the supply of skilled workers grows at more than four times the rate of unskilled workers (an average of 2.4 percent per year vs. 0.6 percent per year). Real GDP per capita growth drops to 4.9 percent per year when the supply of skilled and unskilled workers grows instead at the same rate as the labor force (1.5 percent per year in the NoSkill scenario), and to 4.8 percent per year

[7] For example, in an overlapping generations general equilibrium model, Fehr et. al. predict a 22% increase in high skilled wages vs. a 16% decline in low skilled wages between 2005 and 2050 (pg. 15) due to the increased supply of low skilled labor, which some view as a demographic disaster (Majumder 2013).

when skilled and unskilled labor grow at the rate of total population growth (1.1 percent per year in the Demogr scenario). Since the largest differential is observed between the BaU and NoSkill scenarios, this means that a larger quantity of skills rather than total workers makes a bigger difference to the growth rate of per capita GDP in India.

Table 3: Macroeconomic variables in the three scenarios

		BaU				NoSkill				Demogr			
	2011	2015	2020	2025	2030	2015	2020	2025	2030	2015	2020	2025	2030
National accounts (percent change y-oy)													
GDP at constant prices		6.6	6.9	6.8	6.7	6.3	6.5	6.5	6.4	6.1	6.4	6.4	6.3
Private consumption		6.8	7.1	7.1	7.0	6.4	6.7	6.7	6.7	6.2	6.6	6.5	6.5
Public consumption		6.6	6.9	6.8	6.7	6.3	6.5	6.5	6.4	6.1	6.4	6.4	6.3
Investment		6.2	6.4	6.4	6.3	6.0	6.2	6.3	6.3	5.8	6.1	6.2	6.2
Exports		6.2	6.5	6.4	6.3	5.8	6.0	5.9	5.8	5.6	5.8	5.7	5.6
Imports		6.2	6.5	6.6	6.6	5.9	6.2	6.2	6.2	5.7	6.1	6.1	6.1
Balance of payments (US$ million)													
Current account balance	-73	-75	-97	-127	-167	-75	-97	-127	-167	-75	-97	-127	-167
(as percent of GDP)	-3.9	-3.3	-3.1	-2.9	-2.8	-3.3	-3.1	-3.0	-2.9	-3.3	-3.1	-3.0	-2.9
Balance on goods and services	-121	-137	-189	-266	-382	-138	-191	-270	-389	-138	-191	-271	-390
(as percent of GDP)	-6.4	-5.9	-5.9	-6.1	-6.3	-6.0	-6.1	-6.3	-6.7	-6.1	-6.2	-6.5	-6.9
Exchange rate	*47.9*	*47.6*	*47.9*	*47.9*	*47.7*	*47.4*	*47.6*	*47.5*	*47.3*	*47.4*	*47.5*	*47.4*	*47.1*
Public finance (percent of GDP)													
Overall balance	-11.0	-12.8	-13.7	-14.7	-15.8	-13.1	-14.3	-15.6	-17.1	-13.2	-14.5	-16.0	-17.5
Government revenue	13.2	13.3	13.5	13.8	14.0	13.2	13.4	13.6	13.8	13.2	13.4	13.6	13.7
Total expenditure	24.3	26.1	27.3	28.5	29.8	26.3	27.8	29.3	30.9	26.4	27.9	29.6	31.3
Recurrent expenditure	20.3	22.1	23.3	24.4	25.7	22.3	23.8	25.3	26.9	22.4	24.0	25.6	27.3
Capital expenditure	4.0	4.0	4.0	4.1	4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Memo (percent change y-o-y)													
Employment		1.8	1.6	1.4	1.2	1.7	1.4	1.2	1.0	1.4	1.2	1.0	0.9
Population		1.4	1.2	1.0	0.9	1.4	1.2	1.0	0.9	1.4	1.2	1.0	0.9

The evolution of returns to labor and capital under the three scenarios is shown in Table 4. In the base year, skilled workers earn on average 2.4 times the wages of unskilled labor. Under the BaU scenario, this premium declines to 1.7 times by 2030 as the rapid growth in the supply of skilled labor more than offsets the rising demand due to higher incomes.[8] Under the other two scenarios, however, the skill premium instead rises further to about 2.8 times the unskilled wage. This suggests that India's current skill mix (in terms of the share of skilled workers in the overall labor force) is unlikely to be sufficient to meet the needs of a rapidly growing economy, but also that skill premiums could decline somewhat over the next two decades unless growth accelerates beyond BaU assumptions or demand shifts more strongly into goods which require higher skill content to produce.

The non-farm premium widens in all three scenarios as demand shifts further away from agricultural goods and into manufacturing and services. This is true despite acceleration in the migration of unskilled labor from farm to non-farm activities in response to the rising wage differentials, and this shift is particularly pronounced in the BaU scenario due to more rapid overall income growth. Returns to capital increase somewhat in the BaU scenario and decline in the two alternative simulations, as initial period capital stock is consistent with a higher growth path than what is realized under the two latter scenarios.

[8] Real wages still more than double for all skill and sector categories.

Table 4: Factor returns in the three scenarios

		BaU		NoSkill		Demogr	
	2011	2030	% Δ per year	2030	% Δ per year	2030	% Δ per year
Labor							
Supply (mln)							
Total	385.6	509.8	1.48	495.1	1.32	475.9	1.11
Skilled	178.5	279.2	2.38	229.2	1.32	220.3	1.11
Unskilled	207.1	230.6	0.57	265.9	1.32	255.6	1.11
Farm	122.4	128.7	0.27	149.0	1.04	143.1	0.83
Non-farm	84.7	101.9	0.98	116.9	1.71	112.4	1.50
Wages (2011 000 Rs)							
Total	106.0	246.7	4.55	266.1	4.97	274.4	5.14
Skilled	153.8	300.8	3.59	405.0	5.23	419.8	5.43
Unskilled	64.7	181.1	5.57	146.3	4.39	149.0	4.49
Farm	43.6	115.4	5.26	93.9	4.12	96.9	4.29
Non-farm	95.2	264.2	5.52	213.1	4.33	215.3	4.39
Capital							
Stock (% of GDP)	230.6	218.7	-0.28	225.6	-0.12	229.1	-0.03
Rental rate	1.00	1.10	0.49	0.97	-0.16	0.94	-0.34

4.3 Inequality outcomes (micro-simulation results)

Under all three scenarios, economic growth is sufficiently rapid to more than halve poverty headcounts at the $2/day (PPP) poverty line, reducing poverty from 69 percent of the population in 2011 to 12-16 percent in 2030 while extreme poverty ($1.25/day poverty line) could fall to single digits . Poverty reduction is most rapid under the BaU conditions, as per capita expenditure growth is fastest in this scenario.

Table 5: Micro-simulation link variables

		BaU	NoSkill	Demogr
Employment, % Δ	Unskilled non-farm	20.3	38.0	32.8
	Unskilled farm	5.2	21.7	16.9
Wages, % Δ in the premium over unskilled farm workers	Unskilled non-farm	9.0	7.3	3.4
	Skilled farm	-36.4	31.1	31.9
	Skilled non-farm	-36.4	31.1	31.9
Consumption p.c., % Δ		175.6	159.0	151.7
Prices, % Δ over total CPI	Food	14.5	10.8	11.8
	Non-food	-3.1	-2.3	-2.5

To be completed…

5. Conclusions

This paper's results demonstrate that the demographic transition and the rising share of skilled workers could have substantial growth benefits for the Indian economy, raising the average per capita GDP growth over the 2011-2030 period by nearly 0.5 percentage points with most of the benefit coming from increasing skills rather than the rising worker/population ratio. Under the BaU scenario, the rising supply of skilled workers somewhat exceeds the demand for skills (despite the fact that growth is driven to a

large extent by skill-intensive service sectors) and the skilled/unskilled wage gap reduces by approximately one-third. In the alternative scenarios, which equalize the rates of growth of skilled and unskilled workers, the supply of skilled labor is insufficient to meet the demands of a rapidly growing economy and skill premiums instead rise by about one-third. In all scenarios, growth is driven increasingly by economic activity in the non-farm sector and, despite rising rural-urban migration, labor demand in the non-farm sector is sufficiently high to result in a small widening of the farm/non-farm wage gap.

To be completed…

6. References

To be completed…