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Economic Growth, Gender Equality and the Demographic Transition in India

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Abstract

The effect of India's demographic transition on economic growth is examined for the 1980-2014 period. A multi-equation model is developed to empirically test the impact of India's demographic transition on economic growth. This paper then makes projections for the economic growth contribution of the demographic transition for the 2016-2040 period. The regression results indicate that rising working-age share has a strong positive effect on total factor productivity growth, which in turn enhances economic growth. However, this paper projects that India may experience a 7.7 percent decline in the average growth rate of real gross domestic product per capita for the time span of 2016-2040 because of the slowdown in its demographic transition. Furthermore, this analysis reveals that India can substantially reduce the magnitude of this decline in the nation's future economic growth by closing the gender gap in the labor market.

Keywords: Demographic dividends, economic growth, total factor productivity, gender gap

I. Introduction

India is the second most populous country in the world with 1.3 billion people. Notably, India has the largest share of youth population in the world. The United Nation Population Fund 2014 report states that "India has the world's highest number of 10 to 24-year-olds, with 356 million – despite having a smaller population than China, which has 269 million young people." India has been undergoing a demographic transition – a shift from high rates of mortality and fertility to low rates of mortality and fertility. Although this demographic transition is formed by the decline in both mortality and fertility rates, the fall in these two rates are not synchronized. Coale and Hoover (1958) in their seminal book describe how economic development causes a demographic transition from high mortality and fertility to low mortality and fertility. During the first phase of economic development, mortality declines because of the impacts of economic development on poverty reduction, improvements in medical knowledge and care, nutrition and technology. The fall in mortality then causes a fall in birth rates in the middle phase because of rising costs of raising children as well as higher opportunity costs of having children in terms of forgone work. The authors argue that the decline in fertility rates substantially lags behind the decline in mortality rates.

The demographic transition, thus, in its early stage not only has a positive effect on population growth but also has a very important impact on a country's age structure. In the beginning of this transition, a cohort of children that includes many children who would have previously endured an early death constitutes the first baby boom generation. Because of falling fertility rates families grow smaller, which leads to smaller successive cohorts of children. The age structure effect of this demographic transition forms a "bulge" generation. This recurrent process produces a "demographic wave" that moves slowly through the population. As a result, the share of economically active population rises. In other words, the ratio of people less than 15 years old and people greater than 64 years old to people between 15 and 64 years old falls. Figure 1[1] compares population pyramid for 1997 with the projected population pyramid for 2020 and shows the formation of "bulge" generations.

[1] Please see Adlkha (1997), "Population Trends: India," U.S. Bureau of the Census.

This demographic change known as “youth bulge” can be felt for several generations. This fall in the ratio of dependent to the working-age population tends to increase opportunities for economic growth producing what is known as “demographic dividend”. The dividends or gains can be derived from changes in labor supply, saving and human capital. Since working-age people are likely to be producers and savers, an increase in the working-age share in the total population tends to increase the supply of labor and savings. Also, as the fertility rate begins to fall, families will have more resources to spend on their children’s education resulting in an increase in the accumulation of human capital.

Although there is a number of previous studies examining the economic consequences of population growth, the empirical studies examining the contribution of a demographic transition characterized by rising working-age share are rather limited. The contribution of demographic dividends to economic growth is often ignored in the literature although the emerging evidence supports the positive growth effect of rising working-age share. A number of researchers - Bloom and Williamson (1998), Bloom, Canning and Malaney (2000), Bloom and Finlay (2009) and Mason (2001) among them – suggest that demographic dividends can explain as much as one third of East Asia’s spectacular economic growth. Cai and Lu (2016) examine the growth effect of China’s demographic transition. They show that the demographic dividend contributed to nearly one fourth of economic growth China experienced in the past three decades. They also argue that diminishing demographic dividends is the main reason for China’s economic slowdown after 2010.

Golley and Tyers (2010) investigate in their paper the timing of demographic transitions in China and India. They use an alternative measure of dependency to predict how long the demographic dividends will last for both countries. Their results show that the positive contribution of falling youth dependency to China’s real per capita income will last until beyond 2030. They note that India’s dependency ratio falls sharply, and its higher fertility rate compared to China contributes positively to its level of real GDP. However, India’s higher fertility rate leads to a decline in real gross domestic product (GDP) per capita. India can benefit more than China from a falling fertility rate over time.

Bloom and Canning (2004) say in their paper that “the potential of this “demographic dividend” is not always realized; economic growth is not an automatic outcome of changes in the population age structure.” The authors argue that countries can only realize gains from this demographic transformation if the working-age population is able to participate in the labor market effectively. The empirical results of their paper indicate that the gains associated with a country’s demographic change depend on its adoption of good policies.

The potential positive effects of the demographic transition in India are, thus, not guaranteed. India can achieve the gains associated with its demographic transitions only if India adopts right policies and investments. Note that this demographic transition in India will eventually slow due to falling fertility rates and the slowdown in the fall in death rates. Without right policies and investments, India will miss this one-time opportunity to achieve rapid economic growth and stability.

The purpose of this paper is to examine the effect of India’s demographic transition on its economic growth. In particular, using time-series data covering the time span of 1980- 2014, this paper attempts to empirically test whether India can take advantage of this one-time opportunity to attain rapid economic growth and stability. Additionally, following Marone (2016) and Bloom et. al. (2010), this paper projects the contribution of demographic transition to economic growth for the 2016-2040 period. This study then predicts how India can increase the impact of its demographic gains on future economic growth by closing the gender gap in the labor market.

II. The Model

This paper begins with the well-known *sources of growth* equation derived in a conventional manner from the neoclassical production function to develop a regression model to estimate the effect of rising working-age share on economic growth. The neoclassical production function is often written in the following familiar Cobb-Douglas form linking real gross domestic product (GDP) to total factor productivity, capital stock and labor force.

$$Y = AK^{\alpha}L^{1-\alpha}\,, \qquad (1)$$

where, Y, A, K and L are real GDP, total factor productivity, the quantity of capital and the quantity of labor. α and $1\text{-}\alpha$ are the relative shares of capital and labor. This paper divides both sides of equation (1) by L to measure economic growth in per capita terms.

$$y = Ak^{\alpha}, \qquad (2)$$

where the lowercase variables y and k are real GDP and capital stock in per capita terms, respectively.

Converting equation (2) into natural logs and differentiating with respect to time yields,

$$D\,y = D\,A + \alpha D\,k\,, \qquad (3)$$

where, D y, D A, and D k are the growth rates of real GDP per worker, total factor productivity, capital per worker, respectively.

The relationship between economic growth and the growth in the working-age share based on equation (3), the basic sources of growth equation, can now be empirically tested by adding the growth rate of the working-age share. To minimize the omitted variable bias, this paper also adds the growth rate of human capital to the economic growth equation. The role of human capital in the form of educational attainment has been emphasized by a large number of theoretical models of economic growth such as the models developed by Nelson and Phelps (1966), Lucas (1988), Becker, Murphy and Tamura (1990), and Rebelo (1998). Barro (2001) provides empirical support for the role of human capital in the economic growth process. Adding the growth rates of the working-age share and human capital to equation (3) yields,

$$Gr(Y/N) = a_o + a_1Gr(tfp) + a_2Gr(K/N) + a_3Gr(hc) + \, a_4Gr(WA/N)\,, \qquad (4)$$

where, *Gr(tfp)*, *Gr(hc)*, and *Gr* (WA/N) are the growth rates of real total factor productivity, human capital, and the working-age share, respectively. The variable N is the total population. Note that in equation (4) we divide GDP and capital by the total population, N, instead of the labor force because labor force data in India are not available prior to 1990. Thus, $Gr(Y/N)$ and $Gr(K/N)$ in equation (4) are now the growth rates of real GDP per capita and per capita capital stock, respectively. Population is often used in place of the labor force in studies on economic growth in developing countries because the official labor force data seldom reflect the true supply of formal and informal labor in developing countries.

A. *Dealing with the Simultaniety Bias*

The coefficient estimates of equation (4) would most likely be biased and inconsistent due to the presence of likely simultaneity between economic growth, *Gr(Y)*, and the growth rate of real total factor productivity, $Gr(tfp)$. Generally, total factor productivity measures the efficiency with which labor and capital are combined to produce output. Therefore, total factor productivity primarily depends on an economy's ability to innovate. According to Schumpeter's theory of creative destruction, firms undertake an innovation because it has the possibility to generate higher profits. Schumpeter argues that innovation requires the use of productive resources and so innovation is costly. Therefore, it is necessary for the firms to be profitable to cover the costs of innovation. Since firms' profitability increases when an economy experiences sustained high growth, firms have more incentive to innovate in an economy experiencing sustained growth. Moreover, sustained high economic growth makes firms more optimistic and confident about their future profitability, which in turn encourages firms to take more risks and innovate.

Note that a number of researchers - Acemoglu, Aghion and Zilibitti (2002), Polterovich and Tonis (2005) among them - argue that the levels of innovation vary with the stages of development. Their studies show that countries at early stages of development choose to imitate the technologies of advanced countries since imitation is cheaper than innovation whereas more advanced economies tend to switch to innovation. Thus, it is likely that there exists a reverse relationship running from economic growth to total factor productivity growth.

There might also exist a bi-directional relationship between economic growth and the growth rate of per capita capital stock. A number of researchers - Hongyu, Park and Siqi (2002) among them - using time-series data, find that economic growth stimulates both housing and non-housing investment. The problem of simultaneity is, of course, best addressed using a simultaneous equation model (SEM). To the best of my knowledge, most previous studies have not employed a SEM to estimate the growth effect of a country's demographic transition. The following SEM that explicitly specifies several hypothesized simultaneous relationships is, therefore, constructed in this paper.

$$Gr(Y/N) = a_o + a_1 Gr(tfp) + a_2 Gr(K/N) + a_3 Gr(hc) + a_4 Gr(WA/N) + t + \varepsilon_1$$

$$Gr(tfp) = b_o + b_1 Gr(Y/N) + b_2 Gr(WA/N) + b_3 Gr(hc) + b_4 Gr(G/Y) + b_5 TOT + t + \varepsilon_2 \quad (5)$$

$$Gr(K/N) = c_o + c_1 Gr(Y/N) + c_2 Gr(K_f) + c_3 R_{int} + t + \varepsilon_3 \ .$$

In addition to those variables introduced earlier, $Gr(G/Y)$ and TOT are the growth rates of the share of government consumption in GDP and terms of trade, respectively. $Gr(K_f)$ is the growth rate of inflow of real foreign capital and R_{int} is the real interest rate. The second equation of model (5), which explains $Gr(tfp)$, is inspired by Nachega and Fontaine (2006) and Bloom et. al. (2010). The second equation specifies that total factor productivity growth depends on the growth rates of real GDP per capita, the working-age share, human capital, the share of government consumption in GDP and terms of trade. As explained earlier in this paper, the growth of the working-age share is expected to increase the accumulation of human capital, which in turn is likely to enhance total factor productivity growth. Therefore, economic growth, $Gr(Y/N)$, in the first equation of the SEM depends on total factor productivity growth, $Gr(tfp)$, which in turn depends on the growth of the working-age share,

$Gr(WA/N)$, in the second equation of the SEM. Thus, the growth of the working-age share also affects economic growth indirectly through total factor productivity growth. The third equation explaining the growth rate of per capita capital stock, $Gr(K/N)$, is developed following Sprout and Weaver (1993) and Esfahani (1991) and it addresses the issue of simultaneity between *Gr(Y)* and $Gr(K/N)$. $\varepsilon_{1,}$ $\varepsilon_{2,}$ and ε_3 are stochastic error terms with zero mean and finite variance.

III. Data

Model (5) is estimated using time-series data for the 1980-2014 period. The Appendix provides a detailed description of variables and data sources. Note that some of the time-series variables in model (5) may be nonstationary. Regressions involving independent nonstationary variables tend to generate "spurious" results, that is, conventional time-series tests are biased toward finding a significant relationship among variables in levels when in fact none exists.[2] The standard method for detecting nonstationary behavior in a time-series is to test for the presence of a unit root. Testing can be extended to incorporate the prospect of a deterministic trend as well as the stochastic type of trend represented by a unit root. A number of tests can be found in Said and Dickey (1984), Kwiatkowski et. al. (1992), Perron (1988), Phillips (1987), and Phillips and Perron (1988). The PP test is applied to detect the existence of unit roots in the variables in model (5). The PP test assumes the null hypothesis of a unit root.

Table I reports the unit root test results. The test results confirm that a unit root is present in $Gr(K/N)$, $Gr(hc)$, and $Gr(WA/N)$. A common method of dealing with the presence of unit roots is to take first differences of the variables prior to estimating a model containing them. All variables that are found to be nonstationary are differenced. The differenced variables are then analyzed with the PP test and they are found to be stationary. All variables that are found to be nonstationary in levels are entered into the model in their first differenced forms. A time trend, t, is included in each equation to capture the effect of a potential deterministic trend in the variables estimated in levels.

IV. Estimating the Simultaneous Equation Model

Model (5) is estimated by three-stage least squares (3SLS). Table II presents the complete 3SLS estimates of model (5). In the first equation, explaining the growth rate of real GDP per capita, the variable $Gr(WA/N)$ has a negative and significant coefficient. Since this paper is measuring economic growth by the growth rate of real GDP per capita, the negative coefficient implies that the growth rate of the working-age share results in a less than proportionate increase in the level of real GDP. Note that a demographic transition in its early stage not only changes a country's age structure it also increases its population. The negative coefficient indicates that the percentage increase in the level of real GDP is far less than the percentage increase in the total population resulting in a fall in the growth rate of real GDP per capita. In other words, in India an increase in the working-age share fails to increase real GDP adequately to increase real GDP per capita.

The growth rate of total factor productivity has the expected positive effect on economic growth and the effect is statistically significant. Note that researchers generally agree that total factor productivity growth plays a major role in the economic growth process and differences in total factor productivity growth explain most of international income

[2] Known as the spurious regression problem, it was popularized and studied extensively by Granger and Newbold.

differences. Prescott (1997) states “The reason residents of Western Europe and the countries they settled were, on average, 12 times richer than residents of China in 1950 is that sustained growth in total factor productivity began about 1800 in the West, well over 100 years before it began in China.” The growth rate of capital stock has a positive, as expected, and statistically significant coefficient. The coefficient on the growth rate of human capital is positive, as expected, but not statistically significant.

In the second equation that explains total factor productivity growth, $Gr(tfp)$, the coefficient on the growth rate of real GDP per capita, $Gr(Y/N)$, is positive and significant indicating that there exists a bi-directional relationship between economic growth and total factor productivity growth. The use of a simultaneous equation model is, thus, justified. The coefficient on $Gr(WA/N)$ is positive and significant. The results, thus, suggest that the indirect growth effect of rising working-age share through total factor productivity growth is stronger than its direct growth effect. The estimated coefficient for the growth rate of the share of government consumption in GDP, $Gr(G/Y)$, is negative, as expected, but not significant. The estimated coefficients for the growth rate of human capital, $Gr(hc)$, and terms of trade, TOT, are not significant.

In the third equation that explains $Gr(K/N)$, the coefficient on $Gr(Y/N)$ is positive and significant. The statistically positive and significant coefficient captures the reverse relationship running from economic growth to the growth rate of per capita capital stock. None of the other variables in this equation is significant. This equation, however, is not excluded from the model because it captures the reverse relationship between economic growth and the growth rate of per capita capital stock, which might cause the simultaneity bias in the economic growth equation if this equation is left out from the model.

V. Projecting the Economic Impact of India’s Demographic Transition

Following Marone (2016) and Bloom et. al. (2010), this paper projects the demographic transition’s contribution to economic growth for the 2016-2040 period in India. Following Bloom’s method, this paper first divides economic growth into three components: a) the growth of real GDP per worker, b) the growth of the labor force participation rate, and c) the growth of the share of the population between 15 and 64 years old. The three components of economic growth are derived using the following identity that shows the association between the level of real GDP per capita, Y/N, and the share of the working-age population, WA/N.

$$Y/N = (Y/L) * (L/WA) * (WA/N) , \tag{6}$$

where Y/L is real GDP per worker that measures the productivity of labor while L/WA is the proportion of the working-age population between 15 and 64 years old that is in the labor force, the labor force participation rate. Converting equation (6) into natural logs and differentiating with respect to time yields

$$Gr(Y/N) = Gr(Y/L) + Gr(L/WA) + Gr(WA/N) . \tag{7}$$

Equation (7) shows that the growth rate of real GDP per capita is the sum of $Gr(Y/L)$, the growth rate of labor productivity, $Gr(L/WA)$, the growth rate of the labor force participation rate, and $Gr(WA/N)$, the growth rate of the working-age share. Note that this paper is assuming that an increase in the growth rate of real GDP per worker is due to an increase in labor productivity. Using time-series data for the 1991-2015 period, this paper computes the three components of economic growth to measure the contribution of each component to economic growth. The 1991-2015 period is first divided into two sub-periods - 1991-2002 and 2003-2015 - to measure the change in the contribution of each component over time. This paper then projects the average annual growth rate of the working-age share for the 2016-2040 period using the United Nation's projections for the working-age share. Note that the UN data are available at the five-year intervals. This study calculates the missing observations by forward and backward extrapolations of the UN data on working-age ratios.

Table III reports the breakdown of economic growth. Column 1 of table III shows that between 1991 and 2015, India's real GDP per capita grew at an average of 4.85 percent per year. The decomposition of growth indicates that between 1991 and 2015 the growth rate of labor productivity was the largest driver of economic growth contributing 98.6 percent of total growth in real GDP per capita while growth in the working-age share contributed 9.9 percent of total growth in real GDP per capita. However, the average growth rate of the labor force participation rate declined making a negative contribution of 8.66 percent of total growth in real GDP per capita. The negative contribution of the growth rate of the labor force participation rate basically offset the positive contribution of the average growth rate of the working-age share during this period.

Column 2 and column 3 of table III show that India's real GDP per capita on average increased from 3.42 percent in 1991-2002 to 6.12 percent in 2003-2015. This increase in the average growth rate of per capita income is largely due to India's adoption of market-oriented economic reforms and trade liberalization policies in 1991 that have transformed the country from a poor slow-growing country to a fast-growing middle-income country. The growth rate of labor productivity continued to be the main driver of economic growth in both periods contributing on average 90 percent of total growth in real GDP per capita in 1991-2002 and 104 percent of total growth in real GDP per capita in 2003-2015. The growth rate of the working-age share climbed on average from 0.45 percent in 1991-2002 to 0.52 percent in 2003-2015, a 15.6 percent increase from the previous period, while the growth rate of the labor force participation rate declined on average from - 0.11 percent in 1991-2002 to - 0.71 percent in 2003-2015 resulting in a 5.5 percentage decline from the previous period.

Column 4 of table III reports the projected average growth rate of the working-age share for the 2016-2040 period using UN projections and this study's estimations of working-age ratios. This analysis shows that the average growth rate of the working-age share will drop to 0.01 percent in 2016-2040. If the 2003-2015 average growth rates of labor productivity and the labor force participation rate remain unchanged, the growth rate of real GDP per capita will decrease from an average of 6.12 percent to 5.65 percent. In other words, a 7.7 percent decline in the average growth rate of real GDP per capita will occur due to the slowdown in India's demographic transition. Note that our results from the estimation of a SEM show that the growth of the working-age share enhances total factor productivity growth. Prescott (1997) argues in his paper that total factor productivity enhances labor productivity not only directly but also indirectly as capital per worker depends on total factor productivity. Therefore, the slowdown in the demographic transition will also lead to a decline in labor productivity, which in turn will further reduce economic growth.

VI. The Economic Impact of Closing the Gender Gap in the Labor Force

This study's projections for the economic growth contribution of the demographic transition underscore the fact that as the demographic transition in India slows after 2015, the growth in labor productivity and the growth in the effective participation rate of the working age population in the labor market will largely determine India's future economic growth.

However, this paper finds that the average growth rate of the labor force participation rate in India has been declining between 1991 and 2005, indicating that rising working-age population generated by the demographic transition is not effectively absorbed in the labor force. This falling labor force participation rate is primarily driven by low and falling female labor force participation. Das et. al. (2015) state "India has one of the lowest female labor force participation (FLFP) rates …. among emerging markets and developing countries." There is also a significant gap between the labor force participation rates of men and women in India. Moreover, this gap has not narrowed over time. For example, the average male labor force participation rates in 1991-2002 and 2003-2016 were 89.03 percent and 86.88 percent, respectively, while the average female labor force participation rates were 37.54 percent and 33.43 percent in 1991 -2002 and 2003-2016, respectively. Note that the average female labor force participation rate decreased by 11 percent from the 1991 – 2002 period to the 2003-2016 period while the average male labor force participation rate decreased only by 2.4 percent over the same period.

It should be noted that India's falling female labor force participation and wide gender gap are likely to have significant negative effects on economic growth. Closing the gender gap is, thus, expected to increase the magnitude and potential of demographic gains considerably. Following Marone (2016) and Bloom et. al. (2010), this section, therefore, attempts to assess the magnitude of the economic growth effect of closing the gender gap in the labor market using hypothetical projections of labor force participation rates in which the gender gap in the labor market is eliminated. This paper first simulates labor force participation rates for the 2003-2015 period under the assumption of no gender gap in the labor market in order to compute the no gender gap average growth rate of the labor force participation rate, which is then used to project the average growth rate of real GDP per capita for the 2016-2040 period. If the projected 2016-2040 average growth rate of real GDP per capita under the assumption of no gender gap is greater than the projected 2016-2040 average growth rate of real GDP per capita computed using the official labor force data for the 2003-2015 period, then it can be concluded that closing the gender gap in the labor market enhances economic growth.

Column 3 and column 5 of Table III display projections under the assumption of no gender gap in the labor market. The no gender gap average growth rate of the labor force participation rate is - 0.28 percent and it is reported in the parenthesis beside the actual 2003-2015 average growth rate of the labor force participation rate in column 3 of table III. Column 5 of table III shows that if there were no gender gap in the labor market, the projected average growth rate of real GDP per capita in 2016-2040 will be 6.08 percent. As examined in the previous section, the projected average growth rate of real GDP per capita in 2016-2040 without the assumption of no gender gap will be 5.65 percent, reported in column 4 of table III. Thus, comparing projections of average growth rates of real GDP per capita for these two different scenarios, this paper finds that a 7.6 percent increase in the average growth rate of real GDP per capita can be achieved in 2016-2040 by closing the gender gap in the labor market. Furthermore, this analysis reveals that under the assumption of no gender gap in the labor market, the projected decrease in the average growth rate of real GDP per capita from the 2003-2015 period to the 2016-2040 period will be only 0.7 percent as opposed to 7.7 percent in the absence of gender equality in the labor market. Therefore, gender equality in the labor market reduces the effect of the slowdown in the demographic transition on future economic growth from a 7.7 percent decline to a 0.7 percent decline in the average growth rate of real GDP per capita, thereby substantially increasing the magnitude and potential of India's demographic gains.

VII. Summary and Conclusions

This paper explores the effect of India's demographic transition characterized by a rise in the working-age share on its economic growth. Using time-series data for the 1980-2014 period, this study, specifically, examines whether India can take advantage of this one-time opportunity to attain rapid economic growth and stability. A simultaneous equation model (SEM) is developed to deal with the problem of simultaneity biases in the model for economic growth and demographic transition. In addition, following Marone (2016) and Bloom et. al. (2010), the economic growth contribution of India's demographic transition is projected for the 2016-2040 period. Furthermore, this paper predicts how closing the gender gap in the labor market can increase the magnitude and potential of demographic gains. To the best of my knowledge, previous studies have not used a simultaneous equation model to estimate the growth effect of India's demographic transition. Therefore, previous studies using single-equation models may have produced biased and inconsistent results.

The findings of this paper indicate that total factor productivity growth enhances real GDP per capita growth. As mentioned earlier in this paper, total factor productivity growth is suggested as a critical factor for sustained high economic growth in the literature on economic growth. Shackleton (2013) states, "Over that past century or more, gains in TFP have accounted for well over half the growth in measured U.S. labor productivity (output per hour of work) – that is, they have contributed more to the measured growth of labor productivity than has growth in the amount of capital per worker – and they are likely to be critical for future economic growth as well." Also, the results from the estimation of a SEM show that India's growth in the working-age share increases the level of real GDP but fails to increase the level of real GDP adequately to increase real GDP per capita. Note that the impact of demographic transition on economic growth depends on the effective participation of rising working-age population in the labor market. However, India's falling average growth rate of labor force participation between 1991 and 2015 shows that the increase in the working-age population generated by its demographic transition is not effectively absorbed in the labor market. This might explain why the growth in the working-age share fails to enhance the level of real GDP more than the increase in the total population resulting in a decrease in real GDP per capita.

Additionally, the results also suggest that there exists a bi-directional relationship between economic growth and total factor productivity growth. The use of a simultaneous equation model is, thus, justified. The estimation of a SEM also reveals other interesting results. Notably, the growth in the working-age share enhances total factor productivity growth, which in turn enhances economic growth. Note that the findings of this paper also show that the indirect growth effect of rising working-age share through total factor productivity growth in India is stronger than its direct effect on economic growth.

The projection results of this study reveal that India may experience a 7.7 percent decline in the average growth rate of real GDP per capita in the 2016-2040 period due to the slowdown in its demographic transition. Furthermore, the results indicate that if India closes the gender gap in the labor market, the decline in the average growth rate of real GDP per capita will be only 0.7 percent. Thus, closing the gender gap can substantially reduce the magnitude of the decline in future economic growth.

Finally, this analysis underscores the fact that the magnitude and potential of India's demographic gains post 2015 will largely depend on its growth rates of labor productivity and the labor force participation rate. Note that India cannot realize gains associated with its demographic transition unless this working-age population is able to participate in the labor market effectively, which depends on India's adoption of right policies. In this context, India should make major efforts to support policies that will target increasing female labor force participation and narrowing or closing the gender gap in the labor market. Kumar (2013) argues in his paper that "----the prism of demographic transition shows an extended period of time when the demographic window of opportunity is open and that, barring any calamity, is bound to happen but whether this will be exploited and turned into a boon is not as certain."

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Appendix: Variable List and Data Sources

Y	Real GDP – Penn World Table Version 9.0
N	Population – Penn World Table Version 9.0
$Gr(Y/N)$	Growth rate of real GDP per capita – derived.
K	Capital stock at constant 2011 national prices (2011 = 1) - Penn World Table Version 9.0
$Gr(K/N)$	Growth rate of per capita capital stock - derived
tfp	Real total factor productivity at constant national prices (2011 = 1) - Penn World Table Version 9.0
Gr(tfp)	Growth rate of real total factor productivity – derived
hc	Human capital index - Penn World Table Version 9.0
Gr(hc)	Growth rate of human capital - derived
WA	Working-age population – World Bank
$Gr(WA/N)$	Growth rate of the working-age share - derived
K_f	Inflow of real foreign capital – calculated by subtracting import from export and adding net primary income. The inflow of real foreign capital is derived by dividing the inflow of nominal capital by the GDP deflator – World Bank
$Gr(K_f)$	Growth rate of the inflow of real foreign capital - derived
TOT	Terms of Trade – calculated by the ratio of export price index to import price index - Penn World Table Version 9.0
R_{int}	Real interest rate - World Bank
G/Y	Share of government consumption in GDP - Penn World Table Version 9.0
$Gr(G/Y)$	Growth rate of the share of government consumption in GDP - derived
L	Labor force – World Bank
L/WA	Labor force participation rate – derived
Gr(L/WA)	Growth rate of the labor force participation rate – derived
Y/L	Real GDP per worker – derived
Projected WA	United Nation World Population Prospect – The 2017 Revision
Projected Gr(WA/N)	Projected Growth rate of the working-age share - derived

Table I: Stationarity Tests

Variables	PP Test
$Gr(Y/N)$	- 7.0444*
$Gr(tfp)$	- 6.7282*
$Gr(K/N)$	- 1.9694
$Gr(hc)$	- 2.3204
$Gr(WA/N)$	- 2.9981
$Gr(K_f)$	- 6.6211*
TOT	- 3.5398*
R_{int}	- 5.0018*
$Gr(G/Y)$	- 4.2702*

Notes: * significant at the 10 percent level. The critical value for the PP test with constant and trend at the 10 percent significance level is -3.132.

Table II: Estimated Equations

Equation 1 $Gr(Y/N)$	**Equation 2** $Gr(tfp)$	**Equation 3** $Gr(K/N)$
0.84$Gr(tfp)$ (13.89)**	1.01$Gr(Y/N)$ (13.23)**	0.15$Gr(Y/N)$ (3.78)**
0.82$Gr(K/N)$ (4.53)**	5.25$Gr(WA/N)$ (2.07)**	0.15E-02$Gr(K_f)$ (0.68)
0.63$Gr(hc)$ (0.87)	-0.67$Gr(hc)$ (- 0.79)	0.16E-01R_{int} (0.39)
- 4.37$Gr(WA/N)$ (- 1.97)**	- 0.64E-02$Gr(G/Y)$ (- 0.23)	- 0.24E-01t (- 1.92)*
0.96E-01t (4.81)**	- 0.71E-01TOT (- 0.30E-01)	- 0.11 (- 0.28)
0.94 (2.05)**	- 0.83E-01t (- 2.97)**	- 1.11 (- 0.56)

Notes: t-ratios are in parentheses, E indicates scientific notation;
** - significant at the 5 percent level;
* - significant at the 10 percent level;

Table III

Composition of Real GDP Per Capita Growth, 1991-2040

	(1) 1991-2015	(2) 1991-2002	(3) 2003-2015	(4) 2016-2040 Projections	(5) 2016-2040 No gender gap projections
Real GDP Per Capita Growth *Gr(Y/N)*	4.85	3.42	6.12	5.65	6.08
Breakdown of GDP Per Capita Growth					
$Gr(Y/L)$	4.78	3.08	6.35	----	----
$Gr(L/WA)$	- 0.42	- 0.11	- 0.71 (- 0.28)	----	----
$Gr(WA/N)$	0.48	0.45	0.52	0.01	0.01

Figure 1.
Population of India by Age and Sex: 1997 and 2020

Source: U.S. Bureau of the Census, IPC, International Database.

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