*Measuring demographic dividend: Approaches and Methods

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Abstract

Demographic transition is a long term trend of declining birth and death rates resulting in a substantive change in the age distribution of the population. During the process of demographic transition, there will be a "window of opportunity", during which child dependency ratio decline due to a decline in fertility as well as increase in working age population as children born during the high fertility regime move into working ages. If this window of opportunity is duly utilized, there is a tremendous potential for demographic dividend accures through an increase in savings and investment for economic growth. This paper attempts to study the various issues relating to the measurement of demographic dividend. It is considered both the measurement of on the demographic window as well as the casual relationship between age structure and economic growth. Mechanism of demographic dividend is quite complex, although several approaches to measuring the demographic dividend are available. There are different methodologies for measuring the demographic dividend. Some of them are dependency ratio approach, growth rate approach, potential support ratio, decomposition approach; panel data regression method etc. dependency ratio approach gives importance to the proportion of working age population in different time periods. In growth rate approach demographic window opens and closes between the period when the growth rate of working age population is faster than the child and old age population in a nation. By this approach India's demographic window has started in the 1970's and will last till 2030's. Potential support ratio is another method to estimate

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demographic effects on economic growth. Growth model approach is applied to estimate the demographic dividend by applying several methods such as decomposition model, panel data regression model and simulation model. It is difficult to conclude which method is superior over others each method has its own merits and demerits.

Introduction

The demographic dividend signifies the process of changing age structure and its possible impact on economic development. The demographic transition, for initial period, leads to increase in the working-age population and consequent reduction in the dependency ratio. The swelling of labour force can generate economic benefits in several ways such as supply of labour force, the divergence of resources from children to the physical capital accumulation and investment, female workforce participation due to fertility decline and savings at the household level(Bloom et al., 2009). The demographic dividend is also termed as a demographic gift, demographic bonus and demographic window of opportunities.

The discourse on population change and development is a long-debated issue that was initiated from the work of Malthus (Malthus, 1999).Coale & Hoover(1958)had estimated that the decline in fertility would return huge economic benefits for India. In the same line, Kuznets(1967)observed population growth along with other factors have significant negative effects on economic growth, while Kelley(1988)found no association between population growth and percapita income and savings rates. Using the evidence from the panel data of 165 countries, Lutz et al., (2019) argued that the human capital *i.e.* education triggers both change in age structure and economic growth. Despite these findings, a large body of literature documented that the change in age structure itself has huge economic benefits in India and abroad (Bloom et al., 2006; K. James, 2008; Joe et al., 2018; Mason et al., 2010).

This paper describes the approaches to measuring demographic dividend. Thus, the paper examines the methodology of measuring dividend by considering how effective these methodologies were in understanding demographic dividend in various contexts. Often in the literature, two issues of measurement are discussed. First, the issue of the time horizon of demographic dividend for different countries or regions are discussed. In other words, when is the demographic window opens for different countries and how long it lasts? Second, how does one establish the causality between age structure changes and economic growth? Various methodologies used for both these questions are discussed in this paper.

The Window of Demographic Opportunity

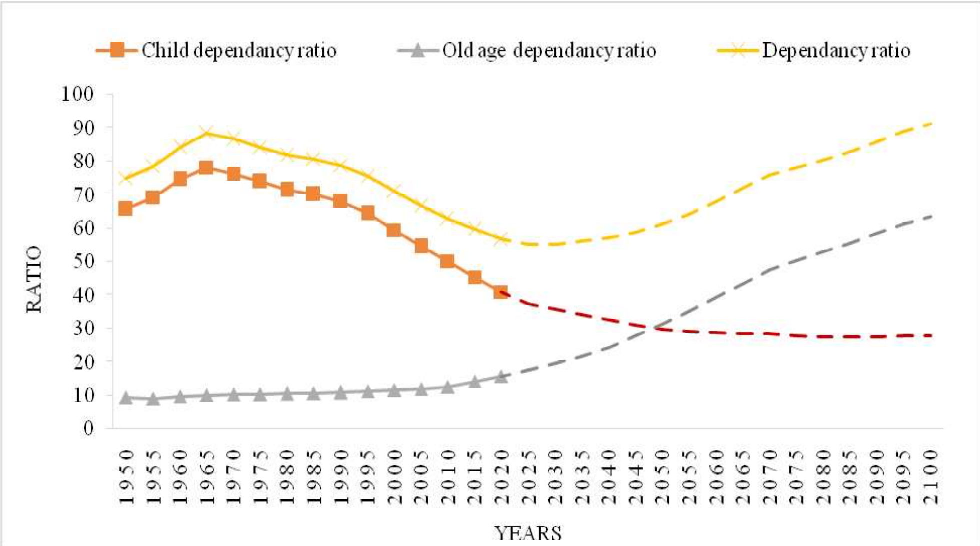
Demographic window is defined as the duration in which the working age population is maximum to create better economic opportunities. This occurs during the course of demographic transition when younger age group population starts declining while the adult population continues to grow due to fertility transition. It is often argued that the demographic window is a short period typically lasts 30–40 years depending upon the pace of demographic transition.

Researchers adopted three major approaches to define the period of demographic dividend. These are the following.

Dependency Ratio Approach

The United Nations Population Division (UNPD) outlines the period of the window of demographic opportunity as the duration when the share of child and adolescent population (defined as aged below 15 years) is less than 30 percent and the share of old age population aged 65 years and above is less than 15 percent. Thus, the approach gives importance to the proportion of working age population in different time periods. In countries where life expectancy is relatively lower like in developing nations, the threshold of the old age population may be considered at 60 years as well. Considering this approach based on United Nations 2019 population estimates (United Nations, 2019), the duration of the demographic dividend of India is between 2015 and 2050. Figure 1 presents the duration of the window of demographic opportunity for India between 1950 to 2100.

Figure 1: Dependency ratios and potential support ratio in India, 1950-2050



Note: Computed from the estimates of World Population Prospects 2019 (United Nations, Department of Economic and Social Affairs, Population Division, 2019); Child dependency ratio is the number of children (0-14 years) to the working-age population (15-59 years); Old age dependency ratio is the number of older population (60+ years) to the working-age population (15-59 years); Dependency ratio comprises child and old-age dependency ratios.

Growth Rate Approach

Although the growth rate approach has been mentioned in different studies and used as an important indicator to measure demographic dividend, it has not been explicitly spelt out for defining demographic window period. In general, it is considered that the demographic window opens and closes between the period when the growth rate of working age population is faster than the child and old age population in a nation. Thus the time period of demographic window can easily be worked out. By this approach India's demographic window has started in the 1970s and will last till 2030s. Although not explicitly stated, such approach appears to be the crux of the analysis of demographic dividend by Aiyar & Mody(2011) and James (2008) etc.

Potential Support Ratio

The support ratio is one of the important tools to estimate the demographic effects on economic growth. A rise in potential support ratio *i.e.* the ratio between the effective number of workers and consumers. The measures of support ratio are varied widely. In some studies, the support ratio is estimated the ratio between working age population (15-60 years) and dependant population (children age less than 15 years and older adults aged 60 years). On the other hand, the support ratio is measured by the ratio between working age population (15-60 years) and old age population (60 years and above). In estimating the potential support ratio, the United Nations' Population Division adopted the second approach by bringing out five scenarios of working age population based on the age groups. Thus, the working age population is defined as population aged 15-64 years, 20-64 years, 20-69 years, 25-64 years and 25-69 years. Poterba et al., (1990)estimates the potential support ratio as the ratio between the effective number of workers and effective number of consumers. The effective number of workers or consumers of each age is calculated as the population at each age weighted by the labour income or consumption profile (Mason et al., 2017). In India, an estimated 30 years of demographic window of opportunity may be considered in this approach (from 2005 to 2035). Based on the potential support ratio, demographic dividends are also classified into two stages. The first demographic dividend which comes directly from the increase in the potential support ratio while the second demographic dividend which is the result extended period of retirement, a powerful incentive to accumulate assets etc (Lee & Mason, 2011) While the period of first demographic dividend is transitory the period of second demographic dividend is undefined.

Causal linkages in Measuring Demographic Dividend:

There are several approaches to measuring demographic dividend. (Lee & Mason, 2006) mention two commonly adopted approaches on the measurement of demographic dividend. Firstly,it is the Growth model approach which uses cross national aggregate time series data for estimating the causality. This approach has been widely used for measuring demographic dividend for number of countries including India. Second approach is the one adopted by Mason(2001)Growth accounting or age allocation of national income. This has been the basic approach adopted by the National Transfer Account project. In addition, there is yet another approach on linking demographic dividend with the progress in the facilitating factors of the dividend. This has been widely used by many researchers to understand the demographic dividend.

Growth Model Approach

The growth model approach is applied to estimate the demographic dividend by applying several methods such as decomposition model, panel data regression model and simulation model. The panel data regression model is applied to assess without distinguishing first and second demographic dividend. The simulation model is applied to mostly projection based data adapting different assumptions. In the following sections the decomposition model, panel data based analyses, and simulation model are discussed.

Decomposition Approach

The first demographic dividend is the direct result of the change in the age structure of population *i.e.* increasing working-age population and fall in dependency ratio. In the *"first demographic dividend"*, the effects of the population age structure on economic outcomes (GDP, growth, consumption, investment, saving) are assessed. The dependency ratio or economic support ratio has a major role in the first dividend.

The second demographic dividend is not uncomplicated. A population concentration in older age groups would have a prolonged period of retirement. In many countries, the economic need of the old age population is either fulfilled by a government program or intergenerational transfer of income. If assurance of old age security is not given either from an intergenerational transfer of income or public support, a sense of a prolonged period of retirement among the working-age population would be a motivation for the accumulation of wealth or saving for the aged period. If these savings are invested, the national income would be grown. This bonus of economic growth is termed as the second demographic dividend. Thus, the *"second demographic dividend"* incorporates the channels of human and physical capital investment.

Dufrénot(2018) proposes the third demographic dividend where he tried to assess the effects of quantitative and qualitative changes in population distribution across the age groups pertaining to the efficiency of the labour force. If the efficiency of labour force is increased, the country can achieve the maximum potential of the demographic dividend.

The First demographic dividend:

The first dividend comes from the changes in age structure that influence the proportion of the working-age population. The decomposition model is widely used to estimate the first demographic dividend in India and abroad (Aiyar & Mody, 2011; Bloom et al., 2006; Chauhan & Arokiasamy, 2018; Joe et al., 2018). Although researchers have used slight different specifications in the model, the fundamental and the simplest way of measuring the per capita income is following (Mason, 2005; Mason et al., 2010).

$$\frac{Y}{N} = \frac{L}{N} * \frac{Y}{L}$$

Although the notations of exact definitions of the model are written differently in various studies, the fundamental idea behind this is that the per capita income (Y/N) is produced based on workforce participation (L/N) and productivity (Y/L). Y, N, and L stand for income, labour force participation and productivity respectively. Let us assume *gr* represents the growth rate. Thus, the above equation may also be presented as follows.

$$gr\left[\frac{Y}{N}\right] = gr\left[\frac{L}{N}\right] + gr\left[\frac{Y}{L}\right]$$

In this equation, the per capita income is categorized into two components namely percentage share of working-age population or support ratio and productivity. Keeping the productivity constant, if the change in age structures *i.e.* increase in support ratio is associated with the rise in growth rate, it is called the accounting effect of the first demographic dividend. The second channel is productivity growth which is quite complicated in terms of conceptualization and computation. It needs a comprehensive understanding from the point of view of changes in age structure, population characteristics and other non-demographic factors.

A simple modification in the life cycle of consumption and production relationships across the age groups or the potential support ratio would be useful in measuring the effective labour and more robust productivity as compared to the previously mentioned approach(Mason et al., 2010). In this proposition, *L* stands for an effective labour force that would be derived from the population age distribution weighted with the labour income from different age groups. So, the effective labour force would be adjusted for the differentials in labour force participation across the age groups, the hours worked, and productivity. Similarly, the effective number of consumers would be computed based on the number of consumer (*N*) with an adjustment of differentials in consumption across the age groups.

$$L(t) = \sum_x y(x)P(s,t)$$

$$N(t) = \sum_x a(x)P(s,t)$$

Where *P*(*x*, *t*) refers to the population in the age group *x* of *t* year, while $y(x)$ is the age-profiling of labour income, and $a(x)$ is the age-profiling of consumption. So, the potential support ratio can be defined as the ratio *L*(*t*)/*N*(*t*).

Relatively recent studies have adopted a more dynamic decomposition model. This model of demographic dividend refers to economic growth as the function of productivity of labour, workforce participation rate and potential support ratio or the ratio between the working-age group and total population. The decomposition analysis assesses the growth rate of these three components separately.

$$\frac{Y}{N} = \frac{Y}{E} * \frac{E}{L} * \frac{L}{N}$$

Where *Y* and *N* are the total income and total population respectively, E is the level of employment of labour force participation, L stands for the supply of labour or population in the working-age group (15-59 years). Thus, the income per capita is the product of three ratios namely productivity (Y/E), labour force participation rate E/L and productive population ratio (L/N). A logarithmic transformation of the above-mentioned identities can be expressed as following(Bloom et al., 2010; Chauhan & Arokiasamy, 2018).

$$g = z + e + c$$

Where *g* stands for growth of income per-capita, *ln(Y/N)*, *z* is growth of income per worker, *ln(Y/E)*, *e* denotes growth of labour force participation, *ln(E/L)* and *c* means growth of population ratio, *ln(L/N)*. Studies also incorporate changes in economic production across the sectors such as primary (*p*), secondary (*s*), and tertiary (*t*) into the model(Bloom et al., 2006; Joe et al., 2018).

The second demographic Dividend:

The second dividend comes from the anticipated capital accumulation due to ageing. The magnitude of the second demographic dividend will be depended upon how the ageing accumulates the savings and shifting of the age profile of wealth (Mason, 2005). The estimation of the second demographic dividend is more complicated than the first demographic dividend because it needs population data for a long period of time and the data on population projection has uncertainty. The capital accumulation of working-age population can be assumed for those who completed their childrearing responsibilities. So, the wealth held to the population aged 50 years and above may be used to estimate the life cycle wealth and second demographic dividend(Mason, 2005). Thus, the accumulation of wealth is the function of the ratio of effective consumption with effective production and the difference between the number of years of effective consumption and production.

$$w(\leq b,t) = \left[\frac{C(t)}{Y^l(t)}\right]\frac{PVN(\leq b,t)}{N(t)} - \frac{PVL(\leq b,t)}{L(t)}$$

Where, $w(\leq b, t)$ denotes the wealth in the year t of those who born in the year b and earlier. $\frac{C(t)}{Y^l(t)}$ is the ratio between consumption per effective consumer and income or production per effective labour in year t. $\frac{PVN(\leq b,t)}{N(t)}$ is the present number of future lifetime effective years of consumption for all persons born in year b per effective producer in year t. Similarly, $\frac{PVL(\leq b,t)}{L(t)}$ is the present number of future lifetime years of production of total person born in year b or earlier per effective producer in year t.

Panel Data Regression Approach

The panel data regression approach is extensively used in assessing the effects of the demographic transition on economic growth. The income per capita is substantially used as a measure of economic growth. Dividing the total income by the working-age population gives us productivity. Applying the neoclassical economic convergence framework, the effects of change in the age structure of population on economic growth is estimated in the previous studies (Barro & Sala-I-Martin, 1995). For instance, (Bloom & Canning, 2004) using the panel data of 75 countries from 1960 to 1995 at an interval of five years find that the effect of the demographic transition on economic growth is varied across the regions due to differences in their economic policies, unemployment and underemployment, deterioration of social capital, human capital investment, crimes, etc. Using the panel data regression from China and India, Bloom et al.(2006)showed significant effects of change in the age structure of population on economic growth after the 1980s in both countries.

In India, the studies using the panel data regression model brought a consensus that India's states are receiving economic benefits from the ongoing demographic dividends. For instance, James(2008) finds that the effects of change in age structure are vivid in India despite the poor education and health conditions. Alike Bloom et al.(2006), Aiyar & Mody (2011) find there is a significant effect of demographic change on economic growth in India since the 1980s. Further, about 2% growth in GDP each year may be contributed by demographic change in India in the next two decades. Similarly, Joe et al.(2018)found that India is receiving significant benefit of economic growth from demographic dividend.

Some studies applied the neoclassical economic convergence framework in assessing the effects of change in the age structure of population on economic growth(Barro & Sala-I-Martin, 1995; Bloom et al., 2006; Joe et al., 2018). The income per worker (*z*) is the gap between income at the initial level (Z_0) and the income level at the steady-state (z^*), and that is also dependent on the speed of convergence (λ). Thus,

$$z = \lambda(z^* - z_0)$$

Where z^* is the function of a number of factors (aX) those influence the economic productivity of the labour. If we keep the labour force participation rate (e) as a constant in the equation of per capita production, the percapita income can be expressed as

$$g = \lambda(aX + e + c_0 - g_0) + c$$

Here, the initial working-age ratio (C_0) and growth rate in the working-age ratio (c) is expected to be positively related.

From the theoretical point of view, the population change and economic growth may have endogeneity. It was argued that there is a possibility of reverse causation between two variables that may lead to erroneous conclusions (Bloom & Williamson, 1998). The simple ordinarily least square (OLS) estimate is inadequate to investigate the impact of age structure change on economic growth (Bloom et al., 2006; Bloom & Williamson, 1998). Therefore, the instrumental variable regression model (2SLS) is applied considering the adult population growth as the instrumental variable(K. James, 2008; Joe et al., 2018). The statistical specifications are the following (K. James, 2008).

$$Y_1 = a_1 + \sum_j \beta_j X_j + \delta_1 Y_2 + e_1$$

Where Y_1 is the growth rate of per capita income, X_j denotes the vector of independent variables that affect the Y_1 barring the growth of the adult population. Y_2 is the growth rate of the working-age population which is derived from the following specification.

$$Y_2 = a_2 + \sum_j \lambda_j Z_j + \delta_2 Y_1 + e_2$$

Where, the adult population growth ($\delta_2 Y_I$) is considered as the instrument variable in the model, Z_j is the vector of the independent variable,e_1 and e_2 are the error terms of the first and the second models respectively.

The third demographic dividend:

The third demographic dividend is the possible missing opportunity which cannot be reaped if the efficiency of labour is not increased. With an increase in labour efficiency, the frontier potential of a demographic dividend can be achieved. Thus, the gap between actual demographic dividend achieved and the potential maximum achievable dividend is termed as "*demographic tax*"(Dufrénot, 2018). In other words, the *demographic tax* is the gap between actual economic growth (for instance GDP per capita) and the highest possible economic growth (maximum potential GDP per capita) due to demographic change. Dufrénot (2018) has estimated the *demographic tax* using the data from Arabian countries. The stochastic frontier analysis (SFA) is used to estimate the demographic dividend where the GDP per capita is the function of the share of the working-age population in total population and the productivity of the working-age population.

Macroeconomic simulation models

The simulation exercise has been used to estimate the potential effects of fertility decline or change in age structure on economic growth from long back when Coale & Hoover(1958)forecasting the population for 35 years (1951-86), estimate the potential economic benefits of reducing fertility in India. The mechanism of the model was that the high population growth and a higher dependency ratio negatively affects the saving, investment and economic growth. It is worth mentioning that the expenditure due to education and health were considered as consumption, not investment. Denton & Spencer(1973) have produced a relatively modern model incorporating the neoclassical production function comprising capital accumulation and labour supply across the age groups. This study considers the fertility and mortality are the exogenous variables and used the data from Canada. Simon (1976) brought the technology in the neoclassical production function by introducing the population size into the model. These estimates have a number of limitations in terms of construction of models.

Kelley (1988)drawn number of obstacles in the construction of a credible model such as potential changes in the assumptions of population projection, lack of available empirical evidence to validate the model, etc.

Relatively newer studies have brought more modern simulation model. Poterba et al.(1990) have included population ageing, savings and capital accumulation in their model. Lee & Mason(2010) incorporated the quality-quantity trade-off in their exercise and does not include constant physical capital or land. The model assumes that the reduction of the number of children will cause an increase in schooling that eventually will return the economic benefits. Recently another study has drawn a more dynamic and comprehensive approach into the simulation model(Ashraf et al., 2013). In this study, aggregate production is assumed to rely on Cobb-Douglas production function comprising the factors of land, physical capital and effective labour.

The simulation models are expanded by bringing in various factors such as physical capital, human capital, quality of labour force etc. (Ashraf et al., 2013; Schultz & Joshi, 2007). In addition to the above-mentioned channels, the effects of a decline in fertility level on health outcomes are also be estimated(Karra et al., 2017). In summary, in the macroeconomic simulation model of assessing the effects of change in population age structure and reducing fertility on the economic growth may also incorporate other potential channels in further studies if the data allow.

National Transfer Accounts (NTA)

The economic life cycle has three separate phases of dependence and independence. The first phase is childhood dependence. The second phase is working-age independence and the third phase is old age dependence. In almost every society, the children consume the resources which are produced by the working-age population through either family or public agency. On the other hand, the older population has assets or saving that was earned during their adult age. However, the aggregate consumption of older population is higher than their earnings. So, the elderly is partially dependent upon the working-age population. Thus, the resources are being transferred from the working-age adults to the children and old age population. The pattern of intergenerational transfer of resources is changed with demographic transition or change in the age structure of the population (Lee, 1994; Lee & Mason, 2011; Mason & Lee, 2011; Zhang et al., 2011).

Using the NTA approach, the demographic dividend can be understood in the following equation.

$$\frac{C}{N} = \frac{(1-s)Y}{L}\frac{L}{N}$$

Where $\frac{C}{N}$ is the consumption per consumer indicating the material standard of living which results from two factors. First is the magnitude of production per workers and consumption *i.e.*1 minus saving rates multiplied by the income per effective worker. The second is support ratio($\frac{L}{N}$) that indicates ratio between number of workers and consumers. The first demographic dividend operates through the change in potential support ratio while the second demographic dividend work through the productivity per worker.

The level of school attendance, childbearing, involvement in the workforce, productivity, saving and consumption varies across the age groups. Thus, the overall gap between consumption and income varies over age groups. When the population share is concentrated in the working-age groups, there will be less consumption and more income and the total savings increases. The national transfer flow account may be presented in the following specification(Lee, 1994; Lee & Mason, 2011).

$$C(x) - Y^{l}(x) = \tau^{+}(x) - \tau^{-}(x) + Y^{A}(x) - S(x)$$

Where $C(x)$ and $Y^{1}(x)$ are the lifetime consumption and income of the labour at each age group (x) respectively, $\tau^{+}(x)$and $\tau^{+}(x)$ denote income transfer inflows and outflows correspondingly for each age group, $Y^A(x)$ and $S(x)$ are asset income and savings consecutively at each age group. If the consumption is higher than the income, it is called '*lifecycle deficit*' and when the income is higher than the consumption, it is called '*lifecycle surplus*'. Thus, the lifecycle deficit and surplus are the function of the balance between income flows and asset-based reallocation. Step by step detailed guide of estimation is described in the United Nations learning manual (United Nations, 2013).

Previous studies applied the NTA framework in investigating the association between ageing and economic growth. It has several limitations (Fine, 2014). For instance, generations are not homogenous across the subgroups of population or regions, even within a family, the intergenerational relationship may be changed over time. Within a geographical setting, the intergenerational flow of resources may be differed more by the socioeconomic groups of population (gender, social groups, ethnicity, wealth status etc.) rather than age. The public support to the disadvantages population is more needed and that should be fundamentals of public policy. Despite these limitations of the NTA approach, intergenerational transfer of resources cannot be denied. In every society, the intergenerational transfer in both public and private sectors is the essential part. Further research in this area need to consider these limitations into account for arriving at more accurate estimates of NTA. Although the use of NTA approach in assessing the effects of change in age structure is widely investigated drawing the evidence from the different countries of the world, the exercise in India is rather limited.

Analyzing the Facilitating Factors of Demographic Dividend

Although the change in the age structure of the population has a great potential to contribute to economic growth, there are serious concerns on the ability of the countries to take advantage of its demographic dividend due to several inherent constraints. The major concern has been the lack of sufficient progress in the facilitating factors of the demographic dividend. Bloom and Canning (2011)considered several distinct forces facilitating the demographic dividend. These forces can be divided into two broad groups, (a) accounting and (b) behavioural forces (Table 1). The swelling of the adult population, which is the age group associated with prime years of saving, provides an accounting benefit during the stages of demographic dividend. But more important benefits accrue through the behavioural mechanism. If the behavioural aspects of demographic changes remain constant, the labour supplies and per-capita savings would likely to follow increasing trend during the first demographic dividend. Among the accounting factors, the effects of swelling of labour force on demographic dividend is extensively analysed using the decomposition model in the earlier sections.

Table 1: Accounting and behavioural facilitating factors of demographic dividend

Accounting	Behavioural
The swelling of adult population	Increase in work participation
Age group associated with prime years of saving	Incentive to save for a longer period with the expansion of life expectancy
	Reallocation of resources from investing in children to investing in physical capital

Source: Bloom and Canning (2011)

On the behavioural aspects of demographic dividend, there are critically two indicators that influence the dividend; the work participation and saving rate.

Change in age structure and savings:

The effects of demographic change on economic savings at the individual, household and national level have been a debated for a long period. Life cycle theory argues that an increase in the middle-aged population (prime age of saving) as compared to the young and older age population enhances the saving rate (Modigliani & Brumberg, 1954). This model considers the adult age as the prime period of earing and savings. The savings will rise if the per-capita income grows. It does not account for the intergenerational transfer of resources, marriage, household formation or labour supply(Schultz, 2005). Demographers have introduced the early life cycle stage of dependency that can suppress the savings in private and public forms (Coale & Hoover, 1958). In this line, a number of studies have documented that after three to four decades of increased national saving rates, it is expected to decline when a significant share of the working-age population will be retiring in their old age (Bloom & Williamson, 1998; Higgins & Williamson, 1996; Mason, 2001). Tobin(1968) has incorporated the ratio of wealth to income in the model. In this analytical framework in the purview of life cycle theory, fertility and mortality are exogenous but the decision of fertility and risk of mortality are internally correlated. If fertility is incorporated in this framework as an endogenous factor, the framework of fertility, female labour force participation and the savings would be more complicated.

Theoretically, the relationship between children and savings is not resolved from the perspective either national or household level. This mechanism of children and adult age has contributed to the extensive study on an overlapping intergenerational model of savings, growth and intergenerational transfer. Keeping other characteristics constant, if parents decide to reduce the family size, saving rates would be increased and accumulated in term of human capital, land and other physical assets. Using this approach, Becker (1991) has theorised the quality-quantity trade-off from the perspective of fertility decline. Other studies also documented the effect of declining fertility leading to human capital investment (Schultz, 2001).

Studies have estimated savings due to change in age structure using different approaches at the macro level. Leff(1969) using 74 cross-country data has shown that if the dependency ratio of a population reduces, the national saving rates increases. This study assumes that the log of gross savings is the function of the share of population under 15 years and above 64 years, controlling for the log of GDP per capita and log of growth of GDP per capita. Adopting a similar framework, Kelley & Schmidt, (1996) find higher savings in the countries where GDP per capita is high. Fry& Mason(1982)incorporating the interaction effect between the proportion of dependent youth and the growth of income in the model find depressing saving rates. Zeng et al.(2019) analysing the data from China have shown that an increase in old-age dependency has a positive impact on housing price (a proxy for saving). Belke et al.(2015) using the evidence from Germany showed that the saving rate increases in the late retirement period. Bloom et al. (2007) find that increased life expectancy increases the saving rates in the country where retirement incentives and pension coverage are ensured.

The micro-level assessment gives a somewhat different picture as the correlation between consumption and income across the age group is not much different. In other words, the consumption does not deviate much from the income across the age groups (Carroll & Summers, 1991; Deaton & Paxson, 1997; Lee & Lapkoff, 1988; Paxson, 1996). Thus, the motivation of savings at the household level is to insure possible risk management that may be encountered in the life course and the leaving bequest for the heirs(Browning & Lusardi, 1996; Deaton & Paxson, 1997).

Work participation

As life expectancy expands, the individuals are expected to work for a longer period of time (Bloom et al., 2007). Kulish et al.(2006)found that the increase in life expectancy is correlated with the stated preference of work force participation. However, the empirical evidence from Australia has shown that the increase in life expectancy did not increase work force participation among the elderly (60+ years). Evidence from OECD countries also indicate a decline in work force participation among the elderly despite rise in life expectancy in last couple of decades.

Even if the individuals do not want to work after the age of retirement, they can be expected to save their earning during the working period for maintaining a high standard of living(Bloom et al., 2003). The study finds an association between increased life expectancy and higher standard of living. Bloom et al., (2007)showed that the increased life expectancy is associated with the rise in savings rate in the countries where universal pension and retirement incentives are provided, but the effects of increase in life expectancy on saving disappears from the countries pay-as-you-go system prevails.

The major dividend as far as the work participation is concerned comes from the increased women's involvement in the labour market due to reduction in the number of children (Bloom et al., 2009).Demographic change particularly the fertility decline is expected to reduce the childbearing and rearing time. So, the women can, potentially, spend more time in the labour market. A number of previous studies find a negative relationship between fertility and female workforce participation. For instance, Joshi & Davies(1992) have estimated the years lost from employment due to childbearing in European countries. The estimates showed that it is around 10 years in Germany, 8 years in the UK, etc. Similarly, other earlier studies have also estimated the effects of fertility on female labour force considering the fertility as '*exogenous*' variable (Gronau & Reuben, 1973; Heckman, 1974; Heckman & Willis, 1977). The magnitude of the association between these two variables is varied across the countries, social group, religion, educational level, etc.

On the other hand, the increasing participation of women in the workforce may reduce the number of children due to raise the opportunity cost(Becker, 1991). However, previous studies using cross-sectional data find both positive and negative relationship between fertility and female labour force participation(Ahn & Mira, 2002; Apps & Rees, 2004; Martínez & Iza, 2004; Rindfuss et al., 2003). Perhaps the cross-sectional data does not capture time lag between female workforce participation and fertility decline (Mishra et al., 2010). Studies using the time-series cross-sectional data showed significant effects of female workforce participation on fertility decline(Kögel, 2004; Oshio, 2019).

The above-mentioned debate indicates that the relationship between fertility decline and female labour force participation is not straightforward. Endogeneity issue pauses methodological challenges in analysing this relationship. There is a possibility that both female labour force participation and fertility may side by side be decided by the unobserved variables such as personal desire on childbearing and career. So, if the variable like personal preference is not accounted in assessing the effect of fertility decline on female labour force participation, the account of the effect may be biased. Therefore, studies have tried to address the issue of endogeneity in modelling(Goldin, 1990; Schultz, 1990; Xie, 1997).

In India, the lack of significant increase in the female labour force participation despite faster fertility transition has attracted wide attention in recent times(Desai, 2010; Klasen & Pieters, 2012). It is argued that India is unlikely to realize its demographic dividend to the fullest extent due to very low work participation of females. Among the pathways to achieve demographic dividend, an increase in female labour force participation, undisputedly, plays an important role in any context(Bloom et al., 2009). There is the potentiality of increasing female labour force participation as the age at first birth still remains low and stopping of births takes place at a relatively young age in India (K. S. James, 2011). That means the women are spending longer periods of time away from childbearing and rearing responsibilities during their adult ages. Hence there is a large potential for women's labour force participation. However, there is a need to study the impact of fertility decline on labour force participation in India.

Assessing the impact of labour force participation in India is not uncomplicated because of a couple of reasons. First, the partial reason for women not participating in labour market is an increased enrolment of women in higher education which would delay the labour market entry. For instance, the percentage of women currently attending educational institutions in the age group 18-24 has increased from 8 per cent in 1995-96 to 15 per cent in 2007-08 according to the National Sample Survey Organisation (NSSO) data. It can have some impact on the labour force participation of females in those age groups. Second, there is a U shaped relationship between economic growth and work participation of women due to the withdrawal of women from agriculture and low paying jobs. This is clear from the fact that most of the decline in the work participation rate of females came from rural areas. The decline was to the tune of 8 percentage points during the period 1993-94 to 2011-12 in rural areas and around 1 percentage point in urban areas during the same period based on NSSO results. Therefore, the relationship between demographic change and female workforce participation is not straightforward and is compounded by several other factors. A detailed analysis is necessary to unpack this relationship in India.

Conclusions

This paper attempted to understand the various issues relating to the measurement of demographic dividend. It considered both the measurement of on the demographic window as well as the causal relationship between age structure and economic growth. It may be pointed out that there are different approaches of measuring both these dimensions. The relationship between change in age structure and economic growth is not straightforward. The measurement poses several methodological challenges. The major approaches to measuring the causal linkages between age structure and economic growth as well as its major challenges are discussed in this paper. Most importantly depending upon the approach, the result of the analysis also alters. This is true of the estimation either on the demographic window period or on the estimation of causal linkages between economic growth and demographic changes. Therefore, the mechanism of the demographic dividend is quite complex. Although, several approaches of measuring the demographic dividend are available, it is difficult to conclude which approach is superior over others. Each one has its own advantages as well as demerits.

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