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RESEARCH ARTICLE

Do economic inequalities impact demographic dividend: Evidence from India

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Abstract

The paper offers a new explanation and prediction of empirical relationship between income and consumption inequalities and demographic dividend. The framework for the analysis is a modified National Transfer Accounts (NTA)-based modelling of the first demographic dividend with inequality-adjusted or inequality-discounted economic support ratio (ESR). The model is tested for India by calculating the inequality-adjusted demographic dividend (or the growth rate of ESR) for the period 2005-2050. The results show that income inequality is not higher than consumption one for all ages and these age-specific economic inequalities have remarkable effects on (i) lowering the observed age-specific distribution of labour income for select ages and consumption for all ages and (ii) reducing the size and duration of demographic dividend due to lower growth rate of ESR. In addition, income inequality effects are found to be stronger than consumption inequality effects in terms of reducing the size of demographic dividend. These results imply that (a) growth effects of the first demographic dividend are upward-biased if unadjusted for the economic inequalities; (b) attainment of goals and targets of the reduction in inequalities under UN-SDGs 2030 by redistributive economic policies are contributory to the maximization of economic growth through the first demographic dividend; and (c) economic inequalities do impact the size and duration of demographic dividend. Subject to the availability of data, the modified approach to the first demographic dividend calculation in this paper is of relevance for comparative studies between India and other countries to draw lessons from mutual experiences and to establish the generality of results.

Keywords

National Transfer Accounts, first demographic dividend, economic support ratio, inequality, India

JEL codes: J110, O53

1. Introduction

India's age structure transition from present to 2100 shows the highest share of working-age population (aged 19-60). If educated, healthy, skillful, gainfully and fully employable, an increasing share of working age population shall result in generation of productive income and its resultant consumption, savings and investment in the economy. This is contributory to higher economic growth in terms of higher growth rate of national income. This process of demographically-induced economic growth, driven by age structure transition, is called potential demographic dividend. However, in real economies, full economic conditions for the realization or reaping potential demographic dividend may not be in place. Consequently, potential demographic dividend may remain a policy objective or target to be attained.[1]

Economic inequalities in the distribution of income and consumption are ubiquitous in real economies, irrespective of their levels of economic growth and development. The impact of inequalities on welfare, poverty and growth is well studied (Handbook of Income…, 2000, 2015; Ahluwalia 1976). Also, well known literature is available on ageing and inequalities (income, wealth and health) in different countries (Deaton and Paxson 1998; Ihle and Siebert-Meyerhoff 2017; OECD, 2019). However, the impact of inequalities on demographic dividend – especially the way inequalities operate through in economic systems and impact demographic dividend – is less studied. This research gap is evident, for instance, in studies on India's demographic dividend, such as, Narayana (2015), Ladusingh and Narayana (2011) and Misra and Mourya (2021). This calls for modeling the economic inequality effects on demographic dividend to explain and predict the positive (promotional) or negative (deterrent) role of inequalities on demographic dividend. In this paper, the author tries to answer this question using the National Transfer Accounts (NTA) methodology.

NTA is a unique methodology that incorporates demographic variables into macroeconomic and income distribution analyses. Essentially, NTA provides with an aggregate framework for introduction of age into National Income and Product Accounts (NIPA). This framework treats an individual as a fundamental unit of analysis and gives quantitative estimates of resource inflows (e.g., labour and non-labour incomes) and outflows (e.g., consumption and savings) by age. This approach recognizes that production and consumption of goods and services differ by age or age groups. Further, the inflows and outflows are extended to the public (or general government) and private (i.e., households and corporate) sectors and allocation of resources is accounted for transfers and asset-based reallocations. Thus, NTA provides an aggregate accounting framework of all inter-age flows of resources that is consistent with NIPA in an accounting year.[2] Theoretical and empirical studies based

1 For instance, India's National Education Policy 2020 (Government of India 2020a) reflects the needs of human capital by emphasizing on investments in education development from the early childhood to higher education. If implemented successfully, this policy shall be contributory for reaping India's future demographic dividend.

2 As per NIPA, the net disposable income for an age group consists of the income earned as part of the productive process, net property income earned from holding financial assets and liabilities, net transfers. Net disposable income is equal to public and private consumption of the age groups plus saving. Thus, full NTA include savings account. Further, a complete set of NTA also includes three additional sub-accounts: an account that documents bequests and other wealth transfers; an account of holding gains that incorporates changes in assets prices and the value of transfer systems; and a balance sheet that reports both assets and transfer wealth. Boundaries of NTA constructions of the savings and other subaccounts are expanded by NTA Network researchers (United Nations 2013; 51-52 pp). India's NTA constructions are not yet expanded to the savings and other subaccounts. These theoretical foundations of NTA are analysed by Mason and Lee (2011a).

on the NTA methodology are diversified in global and country-specific contexts. These studies are published in the seminal work of Lee and Mason (2011b). All knowledge-resources are continuously updated at NTA website (www.ntaccounts.org) for public accessibility at global level.[1] These knowledge resources show the policies which can be supported by NTA in demographically divergent countries and in different policy areas like population ageing, health and education, fiscal sustainability, welfare support systems and COVID-19 impacts.

An elaborate international study on the demographic dividend in the NTA framework is Mason et al. (2017). This study explains the methodology of modeling and estimation of the demographic dividend in international contexts. Demographic dividend is distinguished between the first demographic dividend (FDD) and second demographic dividend. Using NTA age profiles from 60 countries, and approximating those profiles for additional 106 countries, estimates of the FDD for 166 countries have been obtained. The results show that at the global level and over the period from 1950 to 2100, the duration of FDD is about 50 years and contributes to about 0.3 to 0.5 percentage points per year to growth in per capita income (measured by income per equivalent consumer). Further, the results show interesting inter-continental variations in the duration and contributions. For instance, the duration of FDD for Asia is 58 years and the contribution to the growth in per capita income is 0.607 percentage points per year. This is a contrast with Africa which has a longer duration (92 years) and a smaller contribution (0.373 percentage points per year) and Europe which has a shorter duration (38 years) and a lesser contribution (0.376 percentage points per year). Most recently, using NTA first demographic dividend model, Mason et al. (2022) offer evidence for positive impact of age structure transition (over the period 2002-2060) on economic growth in low and middle income countries but not in high and upper middle countries. Over the next 30 years, the differential growth effects of age structure transition may lead to convergence in living standards around the world such that "the projected difference in population-driven per capita consumption growth between the low-income countries and the high-income and upper-middle income countries will be about one percent per annum" (Mason et al. 2022: 15)[2].

Economic inequalities by socio-economic status (SES) have been studied in NTA framework for different countries. For instance, Rosero-Bixby et al. (2016) have studied the inequality in three Latin American countries (Mexico, Costa Rica and Ecuador at different two points). Using NTA profiles, they explain the differences in inequality across countries, nature of redistributive public transfers, inequality by age and impact on population ageing on inequality. Their approach calculates the age profiles of labour income and consumption by controlling for SES (proxied by education level of household head) of individuals. One surprising finding of this study is negative Gini coefficient for the labour income at younger ages in all three countries because the lower SES youngsters have more labour income than higher SES persons. In contrast, the consumption Gini is found to be positive for all ages in all countries. Overall results shows that population ageing may increase inequalities because

1 A new web-based global resources on *Demographic Dividend: Investing in Human Capital*, jointly hosted by John Hopkins Bloomberg School of Public Health and Bill and Melinda Gates Institute for Population and Reproductive Health, is available at: https://demographicdividend.org/

2 Demographic dividend is analysed in a non-NTA framework as well. See, for instance, Bloom (2012) and Bloom et al. (2003).

inequality in income sources increases by age and retirement pensions and asset income are highly unequal.

A latest study on NTA-based economic inequalities by the socio-economic status is Donehower et al. (2021). Inequalities are measured by controlling for education status of a household head (as a proxy of socio-economic status of households) and distinguished by male and female categories and secondary distribution of income through public transfers to answer three interesting questions: 1) what does the generational economy look like by age, sex, socioeconomic status, etc.? 2) how different is inequality by age group? 3) are transfer systems increasing or decreasing inequality? Using the annual time series data for USA for 1981-2018, this study finds evidence for changing inequalities (measured by means or medians at each age) in the quintile distribution of labour income, consumption, public transfers and other variables. For instance, a comparison of the ratio of 1st quintile to 5th quintile distribution of the variables in 1992 and 2017 shows interesting age patterns. First, the ratios for distribution of labour income ranged from about 2 to 3 in 1992 and about 2 to 7 in 2017, especially the ratios rising for older age (60-70 years and above) in 1992. In contrast, the ratios for distribution of consumption ranged between 1 and 2 in both years. This indicated that the inequality in labour income has a bigger effect than the consumption one. Second, in the presence of net public transfers, the ratios for labour income distribution decline below 2 in both years. This implied the inequality-reducing effects of public transfer system, especially for older ages.

Inequalities have been studied in India with a focus on income and consumption inequalities by various socio-economic dimensions. The latest comprehensive review of income, consumption and wealth inequalities in India is Himanshu (2019) in terms of horizontal inequalities based on social groups (i.e., caste), class, religion, gender, and location (i.e., between rural and urban areas and between states) from 1983 through 2011-12. Inequalities have also been studied in India in the context of economic growth (Government of India 2020b). This macro approach correlates inequality and per-capita income with select socio-economic outcome indicators, such as health, education, life expectancy, infant mortality, birth and death rates, fertility rates, crime, drug usage and mental health. However, inequalities by age and impact of inequalities on demographic dividend are still research gaps in India's studies on economic inequalities.

This paper draws lessons from the above NTA literature to offer a new explanation and prediction of empirical relationship between the income and consumption inequalities by age (in brief, income inequality and consumption inequality) and demographic dividend with specific reference to India. Unlike the mentioned above approaches to inequality by the socio-economic status, this paper approaches to use the overall inequality by age where distribution of an NTA-variable is calculated across all individuals at each age. Overall inequality approach is used in Narayana (2021) for analysis of equity of living generations in India. This paper uses the overall inequality approach to answering the following new research questions on India's demographic dividend:

a) Are there unique patterns of age specific economic inequalities?
b) How does inequality relate to and impact the demographic dividend?
c) Will a higher inequality result in shorter and smaller demographic dividend? If yes, will income inequality have a stronger effect than consumption inequality on demographic dividend?
d) Will combined effects of income and consumption inequalities be stronger than individual inequality effect?

e) What do these analyses imply for growth effects of inequality through the demographic dividend channel?

To answer these questions, a modified NTA-based First Demographic Dividend Model is developed with inequality-adjusted or inequality-discounted Economic Support Ratio (ESR). The model is tested for India by calculating the overall inequality-adjusted demographic dividend (or growth rate of ESR) for 2005-2050. This approach incorporates both growth and distributional considerations in the study of demographic dividend and, hence, the results have wider implications for design and implementation of broader economic development policies. Subject to the comparability of labour income and consumption structures, nature and degree of inequality, demographic transition, the approach of this paper can be replicated in other countries. Both replicative and comparative studies are useful to establish the generality of results obtained for India in this paper.

Rest of this paper is organized as follows. Section 2 describes the past, present and future age structure transition of India over the period 1950-2100. The inequality-adjusted NTA-based First Demographic Dividend Model is presented in section 3. Variables and data descriptions are given in section 4. Empirical results are analyzed in section 5. Major conclusion and implications are included in section 6. All tables and figures are sequentially given in the Appendix.

2. India's age structure transition

Data on India's population by single year age is available from the decennial population census reports. The latest Census was conducted in 2011 (Government of India 2011).[1] However, long term population projections by singe year age are not available from the published census reports.[2] To overcome this data limitation and to use a consistent and comparable time series data for 1950-2100, we use the latest United Nations population projections by single year age (United Nations 2019). Although the projections are available by different assumptions of fertility, mortality and migration variants, we use the medium-variant projections throughout.

To start with, changes in India's total population size in the period1950-2100 is shown in Figure 1 in Appendix. From about 400 million in 1950, India's total population has increased to about 1.40 billion in 2021. This current population size is projected to increase and reach a peak at 1.65 billion by 2060 and then decline and reach 1.45 billion by 2100. Along with this demographic transition, India shows a remarkable age structure transition in 1950-2100 as shown in Figure 2 (in Appendix). It is a consequence of demographic transition in terms of dynamic interactions between the fertility and mortality. Age structure transition is measured by the trends in changing share of children (aged 0-18), working population (aged 19-60) and the older population (aged 60 and above) in total population of India. A child is a person aged 0-18. This is as per Article 1 (definition of the child) of United Nations Convention on the Rights of Children or UNCRC (in force since 2 September 1990: India

1 Census of India 2021, 16th census – scheduled to be held in 2021 – has been postponed to 2022 due to COVID-19 pandemic. The processing of Census 2021 results is expected by 2024.

2 For instance, the latest official population projections for India is from 2011 to 2036 (Government of India 2020c). These projections are limited to 5-year interval (2011, 2016, 2021, 2026, 2031and 2036) and 17 broad age-groups (0-4 years to 80+ years) and by singe-years age from 5 years to 23 years.

ratified the Convention on 2 December 1992) and 2013 National Policy for Children (Government of India 2013).[1] Old age or elderly population comprises the senior citizens aged 60 and above. This coincides with the official age for retirement for employees in General Government, qualifying age for recipients of national social pensions (e.g., Indira Gandhi National Old Age Pension) etc.

Considering the long term age structure transition over 150 years (see Fig. 2 in Appendix) is useful in terms of looking at the current age structure in the light of the past for the purpose of future. From 1950 to 1958, share of working-age population in total population was the highest as compared to the share of children and the elderly. From 1959 to 1982, share of child population was the highest. Since 1983, share of working-age population has remained the highest up to now and is projected to be highest up to 2100. For instance, the share of working-age population was 47.09 percent in 1983 and increased to 48.57 percent in 1993, 51.38 percent in 2003, 54.83 percent in 2013 and reached 56.77 percent in 2020. Most importantly, the share of working age population is projected to be 50 percent or higher up to 2100. In terms of its absolute size, India's working age population is projected to increase from 665 million in 2020 to 717 million in 2100.[2] Thus, the estimation of demographic dividend is relevant and important for India's forward-looking economic growth policies.

In addition, India's age structure transition (see Fig. 2 in Appendix) is striking in terms of declining share of children and rising share of elderly population. For instance, share of child (or elderly) population in India's total population shows a decline (or increase) from 45.54 (or 5.35) percent in 1950 to 42.87 (or 6.86) percent in 2000, 23.58 (or 19.09) percent in 2050 and to 18.64 (or 31.72) percent in 2100. It is important to note that the share of India's elderly population (22.07 percent) will exceed the share of child population (21.97 percent) in 2058. India's elderly population is projected to increase from 138 million in 2020 to 163 million in 2025 and to 459 million in 2100. Thus, population ageing shall also be important and relevant for India's estimates of demographic dividend as well as forward-looking economic policies.

It is plausible to translate the above age structure transition in terms of dependency transition in 1950-2100 (see Fig. 3 in Appendix). Dependency transition is measured by the child dependency ratio (total child population divided by total working-age population), old age dependency ratio (total old age population divided by total working-age population), and total dependency ratio (total child and old age population divided by total working-age population). Child dependency ratio dominates over the old age dependency ratio up to 2058 and thereafter the old age dependency ratio dominates over the child dependency ratio up to 2100.

In the presence of child labour and positive work-participation rate for elderly, all children and elderly may not be strictly considered as dependents. However, using NTA methodology, this can be corrected by calculation of the age profile of labour income and its impact on demographic dividend through the economic support ratio. These advantages of NTA methodology are elaborated in the following sections.

1 This definition of a child coincides with different laws in India, such as, Juvenile Justice Act, 2015 and Protection of Children against Sexual Offences Act, 2012. In addition, Indian Contract Act, 1872 prohibits persons below 18 years to enter into a contract and Mines (Amendment) Act, 1952 prohibits them to work in mines and the Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996 prohibits them from working in notified building and other construction works.

2 Working age population includes youth population especially student population who are enrolled in higher education. For instance, the latest All India Survey on Higher Education 2019-20 (Government of India 2020d) show that the gross enrolment ratio in higher education (or post-secondary education) is 27.1 percent for those aged 18-23.

3. Inequality-adjusted demographic dividend model

3.1. General model

To start with, from the production side, per capita gross domestic product (GDP) can be defined as a product of labour productivity (or GDP per employee) and ratio of working population to total population (or number of employees per capita as a measure of labour force participation ratio).

$$Y(t)/N(t) = \{Y(t)/L(t)\}\{L(t)/N(t)\} \quad (1)$$

To express (1) in growth rate terms, we take logarithms of both sides and differentiate with respect to time (t). The resultant equation in terms of growth rate (g) is as follows.

$$g[Y(t)/N(t)] = g[Y(t)/L(t)] + g[L(t)/N(t)] \quad (2)$$

What distinguishes the NTA methodology from the general approach to the measurements of variables in (2) is related L(t) and N(t). That is, $L(t) = \sum\gamma(a)P(a,t)$ is effective number of producers at age a and time t; and $N(t) = \sum\varphi(a)P(a,t)$ is effective number of consumers at age a and time t, where $\gamma(a,t)$ is productivity age profile at age a and time t and $\varphi(a,t)$ is consumption age profile at age a and time t, and P(a,t) is total population at age a and time t.

As per NTA methodology (United Nations 2013), [L(t)/N(t)] is called Economic Support Ratio (ESR) or ratio of effective number of producers to effective number of consumers of goods and services. Effective number of workers refers to number of workers, adjusted for age differences in labour income, to the total population. This measure broadly captures the age variations in labour force participation, hours worked, unemployment, and productivity or wages. Effective number of consumers refers to number of consumers, adjusted for age differences in consumption levels, to the total population. Age structure transition leads to large shifts in the ESR and interacts with labour productivity to determine the economic growth (or growth rate of GDP per effective consumer). A positive growth rate of ESR means that the number of effective workers rises per unit of effective number of consumers. Thus, ESR is essentially different from the standard demographic dependency ratios because the age profile of labour productivity, calculated for measurement of effective number of workers, does capture the labour force participation of both children and elderly population.

Two types of demographic dividend can be distinguished in (2) depending on how dividends operate through (Mason et al. 2017).

i) First Demographic Dividend (FDD) operates through ESR. That is, given growth rate of labour productivity, the period during which growth of support ratio leads to increase economic growth (or growth of GDP per effective consumer).
ii) Second Demographic Dividend operates through the growth rate of labour productivity.

However, the focus of this paper is on FDD.[1]

1 FDD can be modelled from the consumption side as well. This is given in United Nations (2013: 27). In this case, equation (1) is modified as follows: $C(t)/N(t) = \{(1-s)Y(t)/L(t)\}\{L(t)/N(t)\}$, where s is savings rate.

3.2. Introduction of inequality into the first demographic dividend model

Following United Nations (2013: 53), we note that NTA provide the aggregate and per capita flows for each age or age group but no distributional information within age groups. However, inequality is relevant in the FDD model if inequality exists in the age-specific distribution of per capita labour income [γ(a,t)] and per capita consumption [φ(a,t)]. Introduction of inequality into FDD model calls for a framework to integrate inequality through per capita labour income and consumption. For this purpose, we adjust the labour income and consumption profiles for overall inequality by age by multiplying the age profile of per capita labour income by $(1\text{-}G_{yat})$ and age profile of per capita consumption by $(1\text{-}G_{cat})$, where G_{yat} is Gini coefficient of per capita labour income and G_{cat} is Gini coefficient of per capita consumption at age a and time t.[1] As mentioned earlier, overall inequality by age refers to the distribution of per capita labour income or consumption calculated across all individuals at each age. More generally, the inequality adjustments can be expressed as follows.

First, γ(a,t) is adjustable for income inequality by age [γ(a,t)*].

$$\gamma(a,t)^* = \gamma(a,t)\ (1\text{-}G_{yat}), \tag{3}$$

where G_{yat} is a measure of inequality (e.g., Gini coefficient) in labour income distribution at age a and time t. In the same way, inequality-adjusted per capita consumption [φ(a,t)*] results in

$$\varphi(a,t)^* = \varphi(a,t)(1\text{-}G_{cat}), \tag{4}$$

where G_{cat} is a measure of inequality (e.g., Gini coefficient) in distribution of per capita consumption at age a and time t.

Using γ(a,t)* in (3) and φ(a,t)* in (4), the inequality-adjusted effective number of producers and consumers can be calculated as follows.

$$L(t)^* = \sum\gamma(a,t)^*P(a,t) \tag{5}$$

$$N(t)^* = \sum\varphi(a,t)^*P(a,t) \tag{6}$$

where L(t)* is inequality-adjusted effective number of producers, N(t)* is inequality-adjusted effective number of consumers.

Thus, growth effect of inequality-adjusted FDD is measured as follows.

$$g[Y(t)/N(t)]^* = g[Y(t)/L(t)]_{t=0} + g[L(t)^*/N(t)^*] \tag{7}$$

where $g[Y(t)/L(t)]_{t=0}$ is growth rate of labour productivity evaluated at t=0. This implies that growth rate of labour productivity is constant over time.

1 This formulation of inequality adjustment by multiplicative factor (1-G) is traceable to Sen's (Sen 1973) welfare function: W=Y(1-G), where Y is per capita income and G is a measure of relative inequality. Or, W is a measure of inequality-discounted per capita income or "that level of per capita income which, if shared by all, would produce the same welfare (W) as the value of W generated by actual distribution of income" (Sen, 1973: 42). Further, UNDP (1993) used this formulation of inequality adjustment to calculate the distribution-adjusted Human Development Index. Prados de la Escosura (2017) used this adjustment factor to trace the historical evolution of real per capita GDP and Sen's welfare function from 1850 to 2015 for Spanish economy.

Equation (7) is an empirical basis for calculation of the impact of economic inequalities on FDD for India. It can be calculated by the following sequential steps.

a) Age profiles of per capita labour income and per capita consumption are calculated.
b) Age specific Gini coefficients are calculated for labour income and consumption.
c) Age profile of per capita labour income is adjusted for age-specific Gini coefficient of labour income to calculate the inequality-adjusted per capita labour income.
d) Age profile of per capita consumption is adjusted for age-specific Gini coefficient of consumption to calculate the inequality-adjusted per capita consumption.
e) Inequality-adjusted per capita labour income and per capita consumption are used to calculate the effective number of producers and consumers and Economic Support Ratio.

3.3. Operational model

In the absence of time series data for calculation of the age profiles of labour productivity, consumption, and inequalities, they may be assumed as time-invariant or constant over time from the benchmark year. That is, $\gamma(a,t) = \gamma(a)$, $\varphi(a,t) = \varphi(a)$, $G_{cat} = G_{ca,}$ $G_{yat} = G_{ya,}$ for all t in equation (2) through equation (7). Under these assumptions, the equations for calculation of FDD are as follows.

$$g[Y(t)/N(t)] = g[Y(t)/L(t)]_{t=0} + g[L(t)/N(t)] \quad (8)$$

$$g[Y(t)/N(t)]^{**} = g[Y(t)/L(t)]_{t=0} + g[L(t)^{**}/N(t)^{**}] \quad (9)$$

where

$\gamma(a)^{**} = \gamma(a)(1-G_{ya})$;

$\varphi(a)^{**} = \varphi(a)(1-G_{ca})$;

$L(t)^{**} = \Sigma\gamma(a)^{**}P(a,t)$ is inequality-adjusted effective number of producers calculated with time invariant $\gamma(a)$ and G_{ya} in $\gamma(a)^{**}$;

$N(t)^{**} = \Sigma\varphi(a)^{**}P(a,t)$ is inequality-adjusted effective number of consumers calculated with time invariant $\varphi(a)$ and G_{ca} in $\varphi(a)^{**}$;

and all other notations are the same as before.

Equation (9) explicitly shows that the inequalities affect growth but not vice versa. This simple formulation assumes away the reverse effects of growth on inequality. Further, growth effects of FDD are captured without inequalities in equation (8) and with inequalities in equation (9). The difference in results based on equation (8) and (9) for a given year is accountable for the growth effects of inequalities through FDD. However, the empirical results of this paper must be qualified by these assumptions in the formulation of (8) and (9).

Using equations (8) and (9), FDD is calculated up to 2050 from the benchmark year 2004-05. Next, equations (8) and (9) are recalculated from the new benchmark year 2011-12. The new benchmark year 2011-12 rescales the age profiles of labour income and consumption in 2011-12 using the age shapes of 2004-05. Thus, the difference in results of FDD from 2005 to 2050 and 2012-2050, based on equations (8) and (9), shows the impact of benchmark estimates on the size and duration of FDD for the comparable years.

4. Variables and data descriptions

To implement the operational model in section 3.3 above, data are required for measurement of variables and parameters relating to (a) age profiles of per capita labour income

and consumption, (b) age-specific income and consumption inequalities, (c) growth rate of labour productivity and (d) population by single year age from 2004-05 to 2050. Description of variables and data sources and data limitations for these calculations are explained below.

Chapter 3 in NTA Manual (United Nations 2013) gives a detailed description of the methodology for: a) calculation of macro controls or control totals which are aggregate measures of economic flows as measured by gross disposable income in the System of National Accounts (SNA); b) steps in calculation of aggregate and per capita age profiles of variables using micro level and nationally representative surveys; and c) adjustments for macro controls to ensure consistency with survey-based estimates of age profiles. Macro controls are used to scale NTA age profiles so that the NTA macro controls match the estimates from the SNA. We follow this NTA methodology for the calculation of per capita age profiles of labour income and consumption. We do not repeat these methodological details here but focus on describing India's databases for the calculations of age profiles of labour income and consumption. Further, we develop our methodology for calculations of: a) age profiles of inequalities in labour income and consumption; and b) growth rate of aggregate labour productivity. For all measurements, population data is taken from the latest United Nations population projections by single year age and medium-variant (United Nations 2019).

4.1. Age profile of per capita labour income

Macro control for labour income is sum of: a) compensation of employees; b) 2/3 of mixed income; and c) net compensation of employees from rest-of-world. Data for calculation of macro control of labour income in 2004-05 is National Accounts Statistics (Central Statistical Office 2015). Aggregate age profile of labour income is calculated based on individual income from wages and salaries and household income from self-employment (i.e., farm income and non-farm business income) in 2004-05 using the unit level data from the India Human Development Survey 2005 (Desai and Vanneman 2017). This is a micro data on households and individuals from a nationally representative sample of 41,554 households comprising 215,754 individuals, spread over 1,503 villages and 971 urban neighbourhoods. Aggregate age profile of self-employment income at household level is calculated by allocating self-employment income of household to individuals in a household who reported as self-employed, using the age profile of mean earnings of employees. Given the macro adjusted age profile of aggregate labour income, per capita age profile is calculated by dividing it by age-specific population in 2004-05. Aggregate age profile of labour income in 2011-12 is calculated by up-scaling the age profile of aggregate labour income in 2004-05 to macro control of labour income in 2011-12. Per capita age profile of labour income in 2011-12 is calculated by dividing aggregate labour income profile by age specific population in 2011-12. Data for calculation of macro control of labour income in 2011-12 is National Accounts Statistics (Central Statistical Office 2018).

4.2. Age profile of per capita consumption

Aggregate age profiles of public and private consumption are separately calculated by education, health and other consumption. Next, aggregate public and private consumptions are summed and age profile of per capita consumption is obtained. Macro control for calculation of private consumption is Private Final Consumption Expenditure on education, health and others. Households account in India's National Accounts Statistics (in the framework of

SNA) includes Non-profit Institutions Serving Households (NPISHs). Thus, macro controls for private consumption includes consumption of both households and NPISHs. Macro control for calculation of public consumption is Government Final Consumption Expenditure. This refers to sum of individual (education and health) consumption and collective consumption (or public consumption). Source of data for these macro controls in 2004-05 is the National Accounts Statistics (Central Statistical Office 2018). Databases used for calculation of age profiles include India Human Development Survey 2005 (Desai and Vanneman 2017), National Sample Survey on Health Care, Morbidity and Conditions of Aged in India in 2004 and National Sample Survey Organization (July 2004 to June 2005) on Status of Education and Vocational Training in India 2004–2005 (for details, see (Narayana 2018)).

Given macro adjustment, aggregate age profile of consumption is divided by age-specific population to calculate the per capita age profile in 2004-05. Age profile in 2011-12 is calculated by up-scaling the age profile of aggregate consumption in 2004-05 to macro control of consumption in 2011-12 (Central Statistical Office 2018). Per capita age profile of consumption in 2011-12 is calculated by dividing aggregate consumption profile by age specific population in 2011-12.

4.3. Age profile of inequality in labour income

Age profile of labour income inequality is calculated by age specific Gini coefficient. Using the age distribution of individual worker's total labour income from wages and salaries from all types of employment, age-specific Gini coefficient is calculated for 2004-05 and 2011-12. Databases for these calculations are NSS 61st Round in 2004-05 (comprising 602,833 enumerated persons) and NSS 68th Round in 2011-12 (comprising 456,999 enumerated persons) on Employment and Unemployment Situation in India.

4.4. Age profile of inequality in consumption

Age profile of consumption inequality refers to age-specific Gini coefficient. It is calculated in three steps. First, monthly per capita consumption expenditure (MPCE) at i-th age is calculated by dividing total household consumption expenditure on the Mixed Recall Period basis by household size and assigning this per capita household consumption expenditure equally to all household members regardless of their age.[1] Second, MPCE by age is calculated using the age distribution of MPCE. Third, Gini coefficient of MPCE is calculated for each age. Databases for these calculations are NSS 61st Round in 2004-05 (comprising 123,624 households) and NSS 68th Round in 2011-12 (comprising 101,651 households) on Consumer Expenditure in India.

4.5. Growth rate of labour productivity

Labour productivity or output per worker is measured by Gross Value Added (GVA) at constant prices. Growth of labour productivity in 2004-05 is calculated by Compound Annual Growth Rate (%) of GVA (at 1999-00 prices) between 1999-00 and 2004-05. Data for this is

1 Mixed Recall Period refers to the household consumption expenditure over 365 days recall period on five infrequently purchased non-food items (clothing, footwear, education, medical care (institutional), and durable goods) and 30 days recall period on the rest of items.

sourced from Planning Commission (2008). The calculated value of growth of labour productivity per year is 3.01 percent (in 2004-05). In the same way, growth of labour productivity in 2011-12 is calculated by Compound Annual Growth Rate (%) of GVA (at 2004-05 prices) between 2004-05 and 2011-12. Data for this calculation is taken from three sources: a) GVA from Central Statistical Office (2018); b) workforce data for 2004-05 from Planning Commission (2008); c) workforce data for 2011-12 from State of Working India (2018). The calculated value of growth of labour productivity per year is 6.90 percent (in 2011-12).[1]

5. Empirical results

Two sets of empirical results are presented and analyzed: 1) basic results by age profiles of labour income, consumption and inequalities for 2004-05 and 2011-12; 2) analytical results on the FDD with inequalities over the period 2005 to 2050.

5.1. Basic results on age profiles

5.1.1. Age profiles of income and consumption

Figure 4 in Appendix shows the results of per capita age profiles of labour income and consumption for 2004-05 and 2011-12. The levels of variables in 2011-12 are higher for every age than in 2004-05 because the profiles are calculated by up-scaling the age-profile in 2004-05 for the macro controls in 2011-12. It is important to note that age profiles of labour income do not touch the horizontal-axis for the older ages (or after 60 years). This is mainly due to prevalence of unorganised and informal, and self-employed works, in which the elderly individuals are engaged. Thus, the presence of both formal and informal employment in India's labour market is implied in the age profile of labour income. The age profile of per capita consumption shows a steep rise from young to early working ages and stabilizes for middle working ages and older ages. The per capita labour income peaks at age 54 in 2004-05 and 51 in 2011-12. This peak per capita labour income is Rs.46,406 in 2004-05 and Rs.108,941 in 2011-12. On the other hand, the per capita consumption increases rapidly from young to working ages and peaks at age 24 in 2004-05 (Rs.27,182) and at age 22 in 2011-12 (Rs.64,138). Thus, the crossing age from the net consumers to the net producers is from 26 years to 60 years in 2004-05 and from 25 years to 60 years in 2011-12 (see Fig. 4 in Appendix).

The results in Figure 4 (see Appendix) are fundamental for the entire analyses of the FDD because income inequality, consumption inequality, and inequality-adjusted and inequality- unadjusted per capita age profiles of labour income and consumption are essential for calculation of ESR in equations (8) and (9).

5.1.2. Age profile of income inequality

Age profile of income inequality, measured by inequality in distribution of labour income by single year age, is shown in Figure 5 in Appendix. This age-specific income inequality

1 The reference years for calculation of growth of labour productivity are the base years for the estimation of India's national income. For instance, over the period 1999-00 to 2011-12, three official base years were used: 1999-00, 2004-05 and 2011-12. Thus, growth of labour productivity is calculated between 1999-00 and 2004-05 and between 2004-05 and 2011-12, using the base years' prices in 1999-00 and 2004-05 respectively.

(or Gini coefficients) shows the magnitude of intra-age inequality in total labour income in respective years. The age profiles are smoothed by the moving average method for graphical purposes. For all FDD calculation purposes, however, the unsmoothed profiles are used.

Figure 5 (see Appendix) shows a remarkable variation in income inequality in a lifecycle context. That is, inequality is positive in younger ages (≤ 18 years), possibly due to the presence of child labour (≤ 14 years) and rises from younger to working ages. Inequality starts declining for the elderly ages (≥ 60 years). These age patterns of inequality are comparable between 2004-05 and 2011-12 although they show a decline in 2011-12 for all ages except a rise for few elderly ages from age 87.

Interestingly, the calculated value of Gini coefficient within the elderly (≥ 60 years) is 0.421 in 2011-12. This is lower than the Gini coefficient for all age (0.514). This result is in contrast with results in other international studies. For instance, OECD (2019) reported the income inequality for two age groups: the elderly (aged over 65 years) and total population (all ages) for 36 OECD countries and BRICS countries in G20 countries. Our result of Gini coefficient for the elderly is higher than all OECD countries except Mexico (0.500) and our Gini coefficient for all ages is higher than all OECD countries. As compared to other BRICS countries, except China, India's income inequality is higher. However, these comparisons should be treated as merely qualitative because of the differences in definition and measurement of income and inequality. For instance, our definition of income is limited to earnings and self-employed income and OECD (2019) includes income from work, private occupational transfers, and capital income.

5.1.3. Age profile of consumption inequality

Age profiles of consumption inequality by single year age in 2004-05 and 2011-12 are given in Figure 6 in Appendix. The Gini coefficients show the magnitude of intra-age inequality in distribution of consumption in respective years. In general, inequalities increase from the younger ages to working and older ages. Further, inequalities show high variations at the older ages as compared to the young and working ages. Or, variations in consumption inequalities in each year of the older age are remarkable and consumption inequalities strongly matter for the older persons.

Consumption inequalities are higher in 2011-12 than in 2004-05 up to age 16 years. From age 17 years, inequalities in 2011-12 are higher or lower by specific ages. For instance, consumption inequalities are lower in 2011-12 for following ages: 17-19 years, 27-29 years, 38-42 years and from 81-90 years except for age 82 and 85.

5.1.4. Comparability of income inequality and consumption inequality by age

A higher income inequality than consumption inequality is a general finding in many studies on inequalities in India including in the recent studies by Himanshu (2019) and Gradin, Wu (2020). The main reasons for higher income inequality include the following: a) mix of income data by location (rural and urban) and occupation (informal and formal employment); b) under-reporting of income; and c) exclusion of top income in the households surveys.

Our calculations of age-specific inequalities show that, unlike the labour income inequality which is zero up to age 7 (see Fig. 5 in Appendix), consumption inequality is non-zero for all ages (see Fig. 6 in Appendix). This implies that the income inequality is not higher than consumption one at every age. For instance, consumption inequality is higher than income inequality up to age 23 and after age 70. In general, the age groups 0-23 and 71-90

include the dependent ages. Alternatively, this result shows that income inequality is higher than consumption inequality from age 24 years to 60 years which includes the working age population. Thus, age specific inequality measurements shows that the nature and magnitude of income and consumption inequalities vary by age and income inequality is not higher than consumption inequality for all ages. This result is in contrast with the general findings of the above mentioned non-age specific inequality studies on India. Further, this result of age-specific variations in inequalities has important implications on inequality-adjusted demographic dividend because it captures the interactive effects of inequalities and age structure transition through the growth rate of ESR.

5.1.5. Inequality-adjusted age profiles of labour income and consumption

Figure 7 (see Appendix) shows the inequality-adjusted age profiles of per capita labour income and consumption in 2004-05 and 2011-12. These profiles are calculated by using the profiles from Figure 4 and Figure 5 (see Appendix) in the frameworks of equations (3) and (4). Due to the presence of age specific differences in population size, income, consumption and inequalities (except for age group 0-16 years in labour income inequalities), the level and shape of per capita labour income and consumption in Figure 7 are less and different than in Figure 4 (see Appendix). In particular, the shape of age profiles in Figure 7 is mainly determined by age patterns of inequalities in Figure 5 (see Appendix). Thus, the inequality-adjusted age profiles of labour income and consumption in Figure 7 are different in levels and shapes than unadjusted profiles in Figure 4 (see Appendix).

Figure 4 and Figure 7 (see Appendix) are important for calculation of ESR and, hence, FDD in 2004-05 and 2011-12 if adjusted or unadjusted for the inequalities. Sensitivity of analytical results of FDD to these adjustments and un-adjustments to inequalities are analyzed in the following section.

5.2. Assessment of inequality-adjusted first demographic dividend

Analytical results on the FDD are calculated in the presence of both labour income and consumption inequalities and either labour income or consumption inequality.

Using the equations (8) and (9), and age profiles in 2004-05, the results of FDD from 2005 to 2050 are given in Table 1 in Appendix. The calculated ESR and its growth rate are distinguished between the inequality-unadjusted and inequality-adjusted. The results are reported for each year. The values of ESR and its growth rate are highest when adjusted for the consumption-inequality. Or, the FDD is highest and longest (37 years: from 2006 to 2042). In contrast, the values of ESR and growth rate of ESR are lowest, and the duration of FDD is shortest (35 years: from 2006 to 2040), if adjusted for the labour income inequality. These results can be explained by the impact of inequalities on ESR in equation (9). That is, if adjusted for consumption inequality, and other things being equal, the value of ESR is higher because the effective number of consumers is smaller. In contrast, the effective number of producers is smaller and ESR is lesser, if adjusted for labour income inequality.

However, if adjusted for labour income inequality as well as consumption inequality, the values of ESR and growth rate of ESR are smaller but duration of demographic dividend is longer than when unadjusted for the inequalities. This implies that economic inequalities do matter in terms of the size and duration of India's FDD in the period 2005-2050. Moreover, income inequality has a stronger effect on reducing the size and duration of FDD than consumption inequality.

Table 2 in Appendix presents the dynamics of FDD from 2011 to 2050 using the age profile for 2011-12. Qualitatively, these results are comparable to the results of FDD from 2005 to 2050 in Table 1 in Appendix. At the same time, key differences in these results are also evident. First, the size of FDD from 2012 to 2050 is higher in all the inequality-adjusted or inequality-unadjusted scenarios. The higher results are due to many factors including higher labour income and consumption, lower labour income and consumption inequalities for many ages, and higher population size by age (except for age 0-3 years). Second, the duration of the FDD is shortened by two years in all scenarios in Table 2.

Using the data presented in Table 1 and Table 2 (see Appendix), and constant labour productivity growth rate at 3.01 per cent in 2004-05 and 6.90 per cent in 2011-12, economic growth rates, i.e., g[Y(t)/N(t)] in equation (8) and g[Y(t)/N(t)]** in equation (9) are calculated. The results are shown in Appendix in Figure 8 for 2006-2050 and in Figure 9 for 2012-2050. In these figures, the values in the Y-axis is the sum of productivity growth rate and growth rate of ESR in Table 1 for Figure 8 and in Table 2 for Figure 9. Due to the constancy of productivity growth rates, the growth effects of inequality are mainly determined by the FDD or growth rate of ESR under scenarios in Table 1 and Table 2. These results imply that the growth rates are upward-biased if ESR is unadjusted for inequality. For instance, the growth effects are higher if unadjusted for both the inequalities and labour income inequality. However, growth effects of unadjusted ESR do not dominate inequality-adjusted ESR throughout. This is due to interactive effects of both age structure transition and differential inequality in labour income and consumption by age. Thus, inequalities do impact on the size and duration of the FDD and, hence, economic growth in India.

6. Conclusion and policy implications

This paper offers a new explanation and prediction of empirical relationship between income and consumption inequalities and NTA-based FDD model for India. The results show that India's first demographic dividend (FDD) size and duration over the period 2005-2050 have six important determinants: 1) growth rate of aggregate labour productivity; 2) age profile of labour productivity; 3) age profile of consumption; 4) labour income inequality by age; 5) consumption inequality by age; 6) age structure transition. Overall results indicate that the inequalities have remarkable effects on (i) lowering the age-specific distribution of labour income for select ages and consumption for all ages, and (ii) reducing the size of demographic dividend due to lesser growth rate of economic support ratio (ESR). Income inequality effects are found to be stronger than consumption inequality effects in terms of reducing demographic dividend. These results imply that the growth effects of FDD are upward-biased if unadjusted for the economic inequalities. Thus, economic inequality does matter for India's first demographic dividend realization.

The empirical results also imply that the attainment of reduction in inequalities by redistributive economic policies and investments in human capital for increasing the effective number of consumers are contributory to maximization of economic growth through FDD channel. For instance, in the framework of UN-SDGs 2030, redistributive and human capital investment policies for attainment of targets under the following goals, among other, are contributory to reduction in inequality and increase economic growth: Goal 1 (No Poverty),

Goal 2 (Zero Hunger), Goal 3 (Good Health and Well-being), Goal 4 (Quality Education), Goal 5 (Gender Equality), Goal 8 (Decent Work and Economic Growth) and Goal 10 (Reduced Inequalities). However, a detailed study is needed to link between the attainments of targets under these goals, inequalities and FDD for India. This analysis may also have important implications on explaining and predicting the economic and demographic factors which influence the growth rate of labour productivity, age profile of labour productivity, age profile of consumption, labour income inequality by age, consumption inequality by age, and age structure transition.[1]

If distribution of income and consumption change in the process of economic growth and demographic transition, the nature and degree of inequalities by age may also change. These dynamic implications can be captured in this paper if a time series of age profiles of labour income and consumption and inequalities in their distribution can be calculated. Subject to the availability of data in future, these time series calculations of the age profiles can be attempted. This shall be useful to offer either supporting or confronting evidence for India's growth effects of inequality through FDD tested in this paper.

Economic inequalities in this paper are calculated without controlling for any socio-economic status of individuals. Given the socio-economic diversity and disparities, and if controlled for education or other socio-economic status, a future study of inequalities by age may offer new insights into income, consumption and other NTA variables.

Subject to the comparability of labour income and consumption structures, nature and degree of inequality, and demographic transition, the approach of this paper can be replicated for comparative studies in developing countries. These include the BRICS countries who are members of NTA Global Research Network and have constructed NTA profiles. Such replicative and comparative studies will be useful in terms of establishing the generality of results obtained for India in this paper.

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1 In a broader context, these implications may be useful to distinguish inequality of outcome (or consequences of unequally distributed income and wealth) and inequality of opportunity (or key dimensions necessary for fulfilling one's potential). A recent study by ESCAP (2019) shows the inequality of opportunity in Asia and the Pacific for education sector.

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Appendix

Table 1. India's first demographic dividend: calculated values of economic support ratio and its growth rates, India, 2005-2050

Year	Economic Support Ratio (ESR)				Growth rate of ESR (%)			
	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality
2005	0.918	0.651	0.423	1.411				
2006	0.923	0.654	0.425	1.420	0.572	0.559	0.524	0.608
2007	0.928	0.658	0.428	1.429	0.606	0.582	0.546	0.641
2008	0.934	0.662	0.430	1.438	0.622	0.594	0.558	0.658
2009	0.940	0.666	0.432	1.448	0.630	0.609	0.571	0.668
2010	0.946	0.670	0.435	1.458	0.630	0.614	0.574	0.670
2011	0.951	0.674	0.437	1.466	0.531	0.526	0.488	0.568
2012	0.956	0.678	0.439	1.475	0.562	0.566	0.525	0.603
2013	0.962	0.682	0.442	1.484	0.583	0.590	0.547	0.626
2014	0.967	0.686	0.444	1.493	0.584	0.590	0.546	0.628
2015	0.973	0.689	0.446	1.503	0.572	0.577	0.533	0.616
2016	0.978	0.693	0.449	1.512	0.552	0.559	0.516	0.595
2017	0.984	0.697	0.451	1.520	0.533	0.529	0.490	0.573
2018	0.989	0.701	0.453	1.529	0.528	0.522	0.482	0.568
2019	0.994	0.704	0.455	1.538	0.542	0.537	0.495	0.585
2020	1.000	0.708	0.458	1.547	0.559	0.555	0.509	0.605
2021	1.004	0.712	0.460	1.555	0.475	0.469	0.427	0.516
2022	1.010	0.715	0.462	1.564	0.512	0.508	0.462	0.558

Year	Economic Support Ratio (ESR)				Growth rate of ESR (%)			
	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality
2023	1.015	0.719	0.464	1.573	0.530	0.523	0.475	0.578
2024	1.020	0.723	0.466	1.582	0.523	0.512	0.462	0.572
2025	1.025	0.726	0.468	1.590	0.500	0.489	0.438	0.551
2026	1.030	0.729	0.470	1.598	0.454	0.443	0.393	0.504
2027	1.035	0.733	0.472	1.606	0.450	0.434	0.384	0.499
2028	1.039	0.736	0.474	1.614	0.436	0.416	0.368	0.484
2029	1.044	0.739	0.475	1.622	0.419	0.398	0.352	0.465
2030	1.048	0.741	0.477	1.629	0.395	0.372	0.329	0.439
2031	1.051	0.744	0.478	1.635	0.337	0.311	0.274	0.374
2032	1.055	0.746	0.479	1.641	0.325	0.299	0.262	0.362
2033	1.058	0.748	0.481	1.647	0.305	0.282	0.245	0.343
2034	1.061	0.750	0.482	1.652	0.277	0.257	0.218	0.316
2035	1.063	0.752	0.482	1.656	0.240	0.225	0.186	0.280
2036	1.065	0.753	0.483	1.660	0.176	0.164	0.128	0.212
2037	1.067	0.754	0.484	1.663	0.157	0.148	0.114	0.191
2038	1.068	0.755	0.484	1.666	0.131	0.128	0.095	0.163
2039	1.069	0.756	0.484	1.668	0.096	0.106	0.074	0.128
2040	1.070	0.756	0.485	1.669	0.052	0.074	0.041	0.085
2041	1.070	0.756	0.485	1.670	-0.006	0.022	-0.008	0.024
2042	1.069	0.756	0.485	1.670	-0.025	0.011	-0.022	0.008
2043	1.069	0.756	0.484	1.670	-0.045	-0.002	-0.036	-0.011

Year	Economic Support Ratio (ESR)				Growth rate of ESR (%)			
	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality
2044	1.068	0.756	0.484	1.669	-0.064	-0.019	-0.054	-0.029
2045	1.067	0.756	0.484	1.668	-0.090	-0.040	-0.077	-0.053
2046	1.066	0.755	0.483	1.667	-0.129	-0.078	-0.112	-0.095
2047	1.065	0.755	0.483	1.665	-0.127	-0.073	-0.106	-0.094
2048	1.063	0.754	0.482	1.663	-0.131	-0.077	-0.108	-0.100
2049	1.062	0.754	0.482	1.662	-0.143	-0.083	-0.114	-0.112
2050	1.060	0.753	0.481	1.659	-0.163	-0.098	-0.128	-0.133

Source: calculated by the author in the framework of equations (8) and (9).
Note: all calculations are based on constancy of age profiles of per capita labour income and consumption unadjusted for inequalities in Fig. 4 and adjusted for inequalities in 2004-05.

Table 2. India's first demographic dividend: calculated values of economic support ratio and its growth rates, India, 2011-2050

Year	Economic Support Ratio (ESR)				Growth rate of ESR (%)			
	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality
2011	0.966	0.736	0.477	1.492				
2012	0.972	0.741	0.479	1.502	0.632	0.641	0.608	0.665
2013	0.978	0.746	0.482	1.512	0.655	0.667	0.630	0.692
2014	0.984	0.751	0.485	1.522	0.653	0.659	0.623	0.690
2015	0.991	0.756	0.488	1.533	0.637	0.635	0.598	0.673
2016	0.997	0.760	0.491	1.543	0.621	0.617	0.581	0.657
2017	1.003	0.765	0.494	1.552	0.593	0.582	0.549	0.626
2018	1.009	0.769	0.497	1.562	0.583	0.567	0.535	0.616
2019	1.015	0.773	0.499	1.572	0.600	0.584	0.549	0.635
2020	1.021	0.778	0.502	1.582	0.620	0.613	0.573	0.660
2021	1.026	0.782	0.505	1.591	0.536	0.528	0.493	0.571
2022	1.032	0.787	0.507	1.601	0.577	0.569	0.532	0.614
2023	1.038	0.791	0.510	1.611	0.596	0.589	0.550	0.635
2024	1.045	0.796	0.513	1.621	0.587	0.577	0.539	0.625
2025	1.050	0.800	0.515	1.631	0.561	0.547	0.509	0.600
2026	1.056	0.804	0.518	1.640	0.516	0.496	0.459	0.553
2027	1.061	0.808	0.520	1.649	0.508	0.482	0.444	0.546
2028	1.066	0.812	0.522	1.658	0.490	0.459	0.422	0.527
2029	1.071	0.815	0.524	1.666	0.471	0.435	0.399	0.507
2030	1.076	0.819	0.526	1.674	0.446	0.406	0.373	0.479
2031	1.080	0.822	0.528	1.681	0.389	0.344	0.317	0.415

Year	Economic Support Ratio (ESR)				Growth rate of ESR (%)			
	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality	Unadjusted for inequality	Adjusted for both inequalities	Adjusted for income inequality	Adjusted for consumption inequality
2032	1.084	0.824	0.530	1.688	0.372	0.327	0.301	0.398
2033	1.088	0.827	0.531	1.694	0.348	0.307	0.281	0.375
2034	1.092	0.829	0.532	1.700	0.315	0.283	0.255	0.344
2035	1.095	0.831	0.534	1.705	0.275	0.252	0.221	0.306
2036	1.097	0.833	0.534	1.709	0.211	0.192	0.163	0.239
2037	1.099	0.834	0.535	1.713	0.189	0.180	0.150	0.219
2038	1.101	0.836	0.536	1.716	0.162	0.163	0.132	0.193
2039	1.102	0.837	0.537	1.719	0.128	0.138	0.106	0.159
2040	1.103	0.838	0.537	1.721	0.086	0.106	0.074	0.117
2041	1.103	0.838	0.537	1.722	0.032	0.054	0.026	0.060
2042	1.104	0.838	0.537	1.723	0.012	0.039	0.010	0.041
2043	1.104	0.839	0.537	1.723	-0.009	0.023	-0.008	0.022
2044	1.103	0.839	0.537	1.723	-0.028	0.012	-0.020	0.005
2045	1.103	0.839	0.537	1.723	-0.052	-0.006	-0.040	-0.018
2046	1.102	0.838	0.536	1.722	-0.087	-0.047	-0.077	-0.057
2047	1.101	0.838	0.536	1.721	-0.088	-0.045	-0.074	-0.058
2048	1.100	0.838	0.536	1.720	-0.093	-0.047	-0.076	-0.064
2049	1.099	0.837	0.535	1.719	-0.105	-0.059	-0.089	-0.075
2050	1.097	0.836	0.535	1.717	-0.125	-0.076	-0.108	-0.094

Source: calculated by the author in the framework of equations (8) and (9).
Note: all calculations are based on constancy of age profiles of per capita labour income and consumption unadjusted for inequalities in Fig. 7 and adjusted for inequalities in 2011-12.

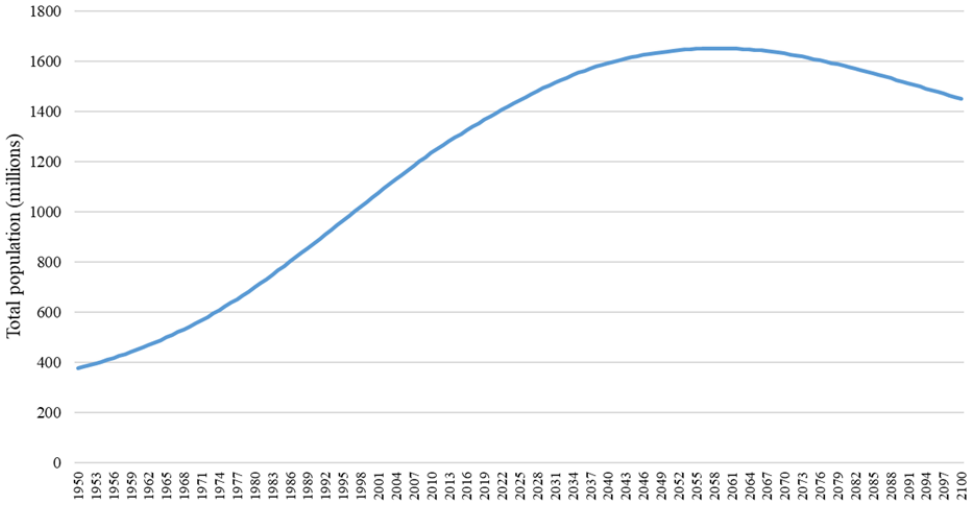

Figure 1. Total population of India, 1950-2100. *Source*: author's calculations based on United Nations (2019) data.

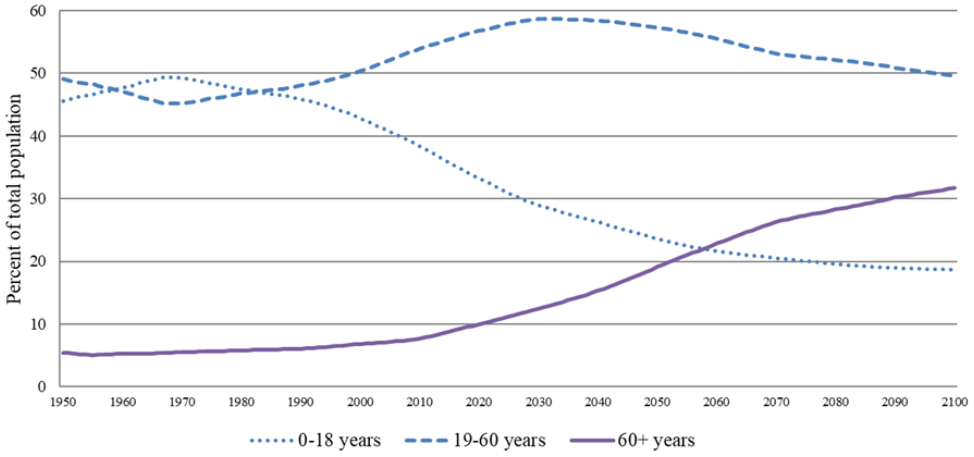

Figure 2. Age structure transition, India, 1950-2100. *Source*: author's calculations based on United Nations (2019) data.

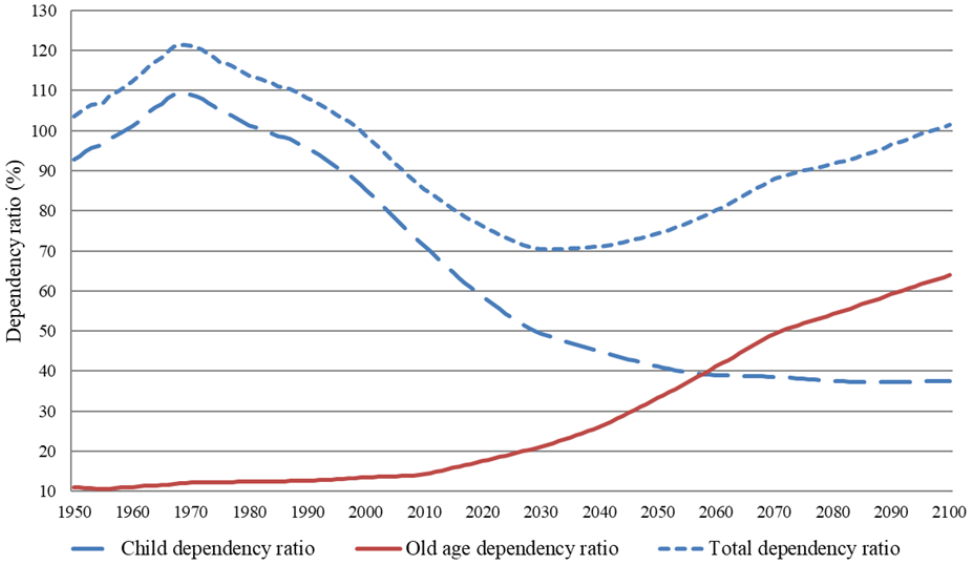

Figure 3. Dependency transition, India, 1950-2100. *Source*: author's calculations based on United Nations (2019) data.

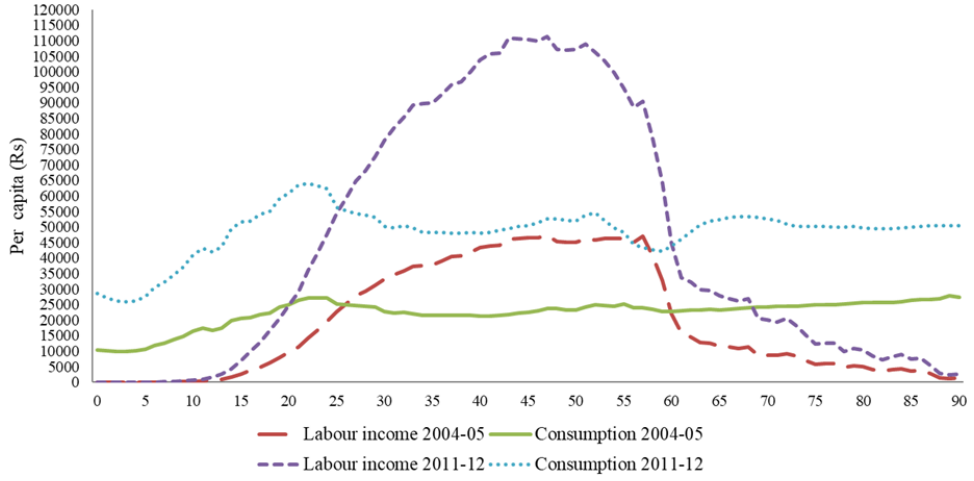

Figure 4. Age profiles of per capita labour income and consumption, India, 2004-05 and 2011-12. *Source*: author's calculations.

Figure 5. Age-specific Gini coefficient for per capita labour income, India, 2004-05 and 2011-12. *Source*: author's calculations.

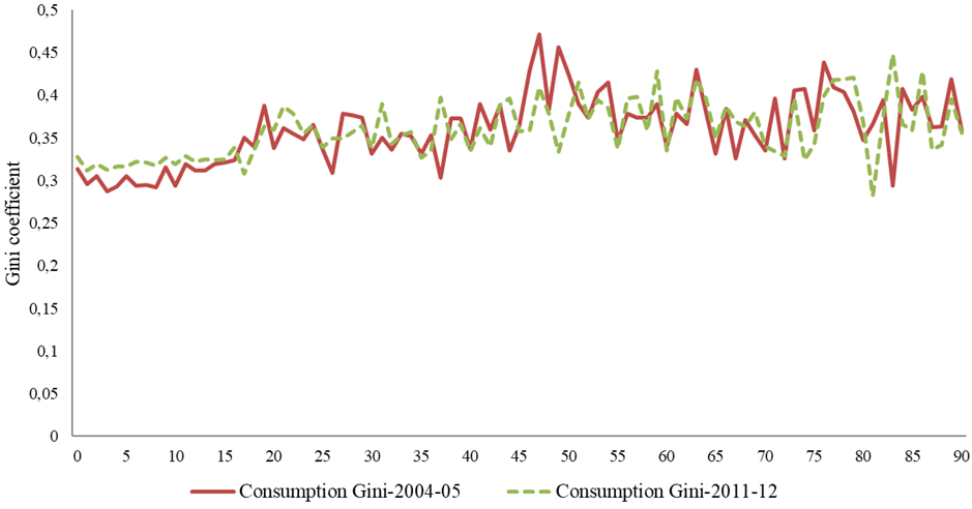

Figure 6. Age-specific Gini coefficients for per capita consumption, India, 2004-05 and 2011-12. *Source*: author's calculations.

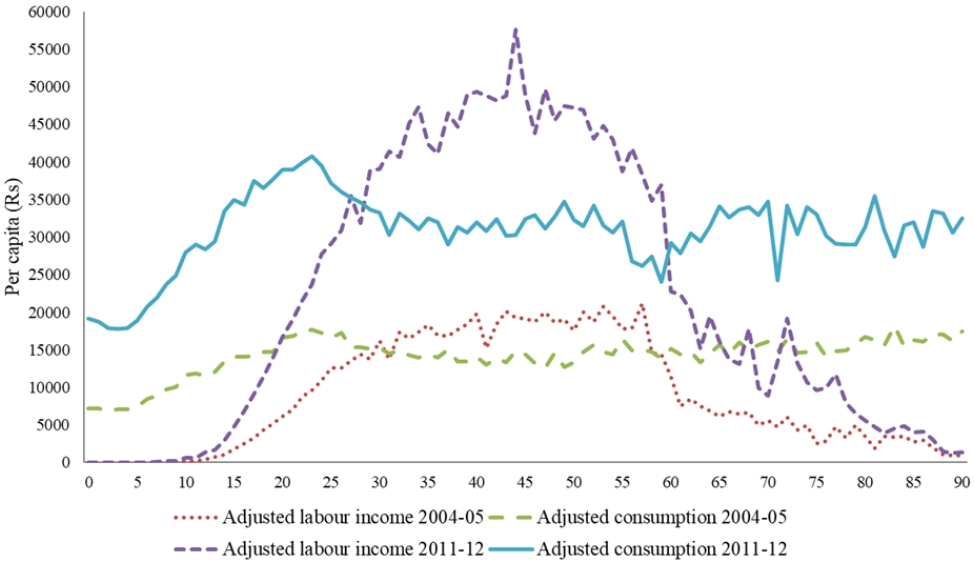

Figure 7. Inequality-adjusted per capita age profiles of labour income and consumption, India, 2004-05 and 2011-12. *Source*: author's calculations.

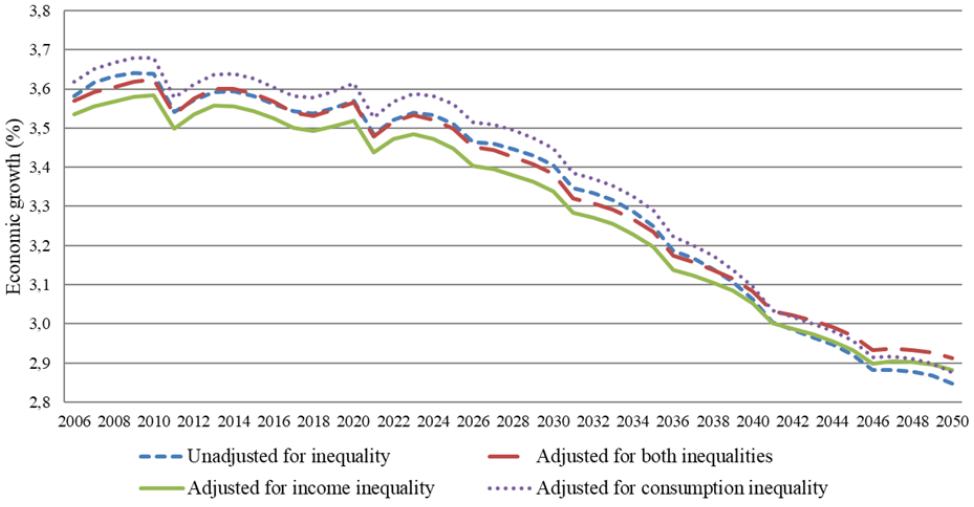

Figure 8. Growth effects of inequality through FDD, India, 2006-2050. *Source*: author's calculations.

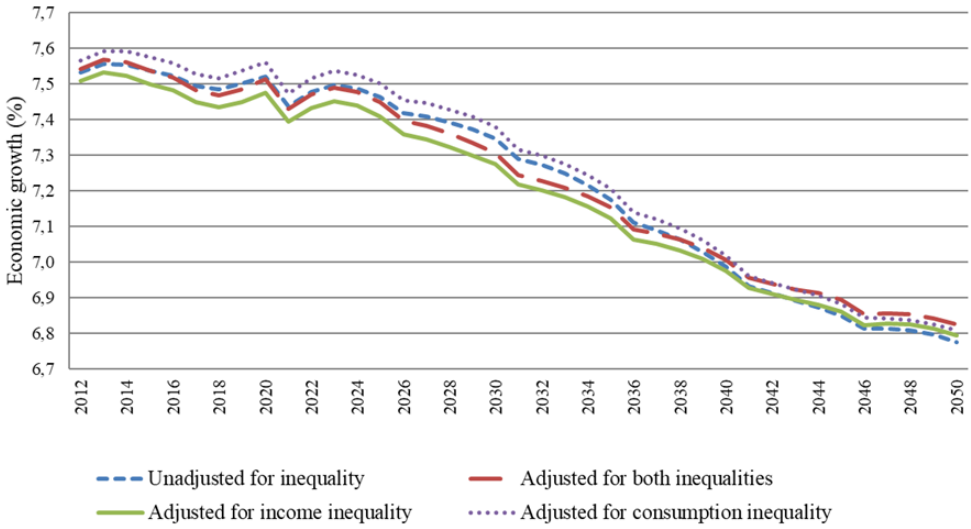

Figure 9. Growth effects of inequality through FDD, India, 2012-2050**.** *Source*: author's calculations.

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