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Future Population Growth in India

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Demographic Components of Future Population Growth in India

Introduction

According to the latest population projections prepared by the Population Division of the United Nations, India's population was estimated to be around 1311 million in mid- 2015 (United Nations, 2015). According to the medium variant of the population projections, India's population is projected to increase to about 1754 million by 2068 and then decrease to around 1660 million by 2100. These estimates are based on the assumption that the country will achieve the replacement fertility sometimes during the period 2030-35 and then the total fertility rate will continue to decrease to 2085 and then increase marginally to reach 1.80 by 2100. These projections also suggest that India will become the most populous country of the world by 2022 surpassing the population of China. These projections, however do not take into account the recent change in the population policy of China from one-child policy to two-child policy. An implication of this policy change in China may be that India may not surpass the population of China as projected by the United Nations Population Division.

In this paper, we analyse the future changes in India's population stock on the basis of the population projections prepared by the United Nations Population Division. By population stock, we mean the size and structure of the population. In a population that is closed to migration, the change in the population stock is determined by the initial population size, changes in fertility and mortality levels and changes in the population age structure. This means that the change in the population stock can be decomposed into the change in the populations stock attributed to the change in the size of the population; change in the population stock attributed to the change in the level of fertility; change in the population stock attributed to the change in the level of mortality; and the change in the population stock attributed to the change in the age structure of the population. Such a decomposition analysis helps in understanding how different drivers of population growth are expected to contribute to the future growth of the population of the country.

The analysis of the key drivers of population growth has always been an area of interest to demographers. The approach adopted for such analyses is based on the projection of the population stock at a future date under a set of assumptions about future trends in the components of population growth (Andreev, Kantorova and Bongaarts, 2013; Bongaarts, 2009; 1994; Bongaarts and Bulatao, 1999; Frejka, 1973; 1981). These analyses are built upon the hypothetical cohort-component projection methodology which is based on the classical demographic transition model. For example, the recent paper by Andreev, Kantorova and Bongaarts (2013) compares four types of population projections - standard, natural, replacement and momentum - to analyse components of future population growth in the world and in different countries of the world. According to this analysis, population momentum resulting from changes in the age structure of the population will be the key driver of the future population growth under the assumption that fertility will sooner or later decrease to the replacement level and will remain at that level for a long period. It is estimated that changes in the population age structure alone will account for an increase of 447 million in India's population between 2010 and 2100.

Methodology

Change in the population stock (size and structure) is the result of changes in factors that affect the stock (Schoen, 2002). In the absence of migration, there are only two factors that affect the population stock - number of births and number of deaths. A birth leads to an increase in the population stock whereas a death leads to a decrease in the population stock. The larger is the difference between the number of births and the number of deaths in a given time period, the larger is the increase in the population stock during that period. The change in the population stock, therefore, is determined by three factors: 1) the initial size of the population stock; 2) the gap between the birth rate and the death rate or the natural population growth rate; and 3) the length of the period during which the given natural population growth rate prevails (Vallin, 2006). A synthetic index that characterises the change in the population stock over time is the population multiplier, which is the number by which population is multiplied between two points of time (Chesnais, 1979; 1986). Population multiplier can be calculated theoretically as well as empirically. The theoretical approach involves approximation either through an analytical model (Keyfitz, 1977) or by numerical simulation (Frejka, 1973). Empirical approach involves examination of historical evidence complemented by long range population projections (Chesnais, 1990).

Number of births and number of deaths in a give time period, on the other hand, are determined by the size of the population and birth and death rate. In turn, birth and death rate are influenced by two groups of factors. The first group of factors include individual fertility and individual mortality or the probability of a birth and the risk of a death. The second group of factors include age structure effects on the birth rate and the death rate since both the probability of birth and the risk of death vary by age. This means that the change in the population stock is determined by the change in the initial size of the population and the change in the national population growth rate. The change in the natural population growth rate is influenced by the change in birth and death rates. The change in the birth rate is determined by the change in the probability of birth and the change in the age structure effects on the birth rate. Similarly, the change in the death rate is determined by the change in the risk of death and the change in the age structure effects on the death rate. These considerations suggest that the change in the population stock should be analysed in terms of the change in the probability of birth, change in the risk of death, change in the age structure effects on birth and death rates and the change in the size of the population.

Fundamentally, the change in the population stock is the elaboration of the basic differential equation

$$\partial P/\partial t = mP \qquad (1)$$

where P is the population stock and m is the force of change which may be an instantaneous rate or probability or risk of change with respect to the demographic behaviour of interest (Schoen, 2002). One special but very useful feature of the change in population stock is that population growth is logically closed. Classically, this is reflected through the balancing equation

$$P(t) = P(0) + B(0,t) - D(0,t) + I(0,t) - O(0,t) \qquad (2)$$

where t stands for time, B(0,t) is the total number of births; D(0,t) is the total number of deaths; I(0,t) is the total immigrations and O(0,t) is the total emigrations during time t. Assuming that population is closed to migration or net migration is either zero or very near to zero,

$$P(t) - P(0) = B(0,t) - D(0,t). \quad (3)$$

Dividing both the sides by PY(0,t), person years lived during time t, we get

$$r = b - d. \quad (4)$$

Here *r* is the natural population growth rate, *b* is the (crude) birth rate and *d* is the (crude) death rate. In the absence of migration, *r* serves as a useful indicator of the change in population stock. When $r=0$, population stock remains unchanged over time. When $r>0$, population stock increases and when $r<0$, population stock decreases. The quantum of increase or decrease in the population stock depends on population size at time 0.

The change in the natural population growth rate over time may be decomposed as

$$\nabla r = r_2 - r_1 = (b_2 - b_1) - (d_2 - d_1) = \nabla_b - \nabla_d. \quad (5)$$

Let *f* denotes the probability of birth or the birth rate independent of age structure effects, then we can write

$$b = f * (b/f) = f * ab \quad (6)$$

The ratio $ab = b/f$ represents the age structure effects on the birth rate. Following Kitagawa (1955), the change in the birth rate can be decomposed as

$$\nabla b = (b_2 - b_1) = f_2 * ab_2 - f_1 * ab_1$$

$$= [(f_2 - f_1) * (ab_1 + ab_2)/2] + [(ab_2 - ab_1) * (f_1 + f_2)/2]$$

$$= \partial_f + \partial_{ab} \quad (7)$$

Similarly, let *l* denotes the risk of death or the death rate independent of age structure effects then we can write

$$d = l * (d/l) = l * ad \quad (8)$$

$$\nabla d = (d_2 - d_1) = l_2 * ad_2 - l_1 * ad_1$$

$$= [(l_2 - l_1) * (ad_1 + ad_2)/2] + [(ad_2 - ad_1) * (l_1 + l_2)/2]$$

$$= \partial_l + \partial_{ad} \quad (9)$$

Substituting from (8) and (9) in (5), we get

$$\nabla r = (\partial_f + \partial_{ab}) - (\partial_l + \partial_{ad})$$
$$= (\partial_f - \partial_l) + (\partial_{ab} - \partial_{ad}) = \partial_i + \partial_a \qquad (10)$$

Equation (10) suggests that the change in the natural growth rate *r* over time is the algebraic sum of the change in fertility or the probability of death; change in mortality or the risk of death; change in the age structure effects on the birth rate; and the change in the age structure effects on the death rate. A decrease in fertility results in a decrease in the natural growth rate. Similarly, a decrease in the age structure effects on the birth rate also leads to a decrease in the natural growth rate. On the other hand, a decrease in mortality as well as a decrease in the age structure effects on the death rate results in an increase in the natural growth rate. Equation (10) suggests that the change in the natural growth rate can be broken down into change in intrinsic growth rate which is determined purely by fertility and mortality levels while the other is determined totally by the change in the age structure effects on birth and death rates. Equation (10) thus addresses the issue of which demographic indicators are more efficient in analysing the change in the population stock over time. It takes into account both the change in fertility and mortality levels and the change in the population age structure in explaining the change in the population stock.

Application of equation (10) requires measurement of the probability of birth or the birth rate independent of age structure effects (*f*), and the risk of death or death rate independent of age structure effects (*l*). The most commonly used measure of the probability of birth is the total fertility rate (TFR). Horiuchi (1991) has shown that the ratio of the birth rate to the total fertility rate is a measure of age structure effects on the birth rate. The unit of measurement of the birth rate is however different from the unit of measurement of the total fertility rate. It may however be noted that the total fertility rate is actually the un-weighted sum of age-specific birth rates. Dividing the total fertility rate by 35, the length of reproductive life span, gives the average birth rate per woman of reproductive age group. Finally, multiplying the average birth rate per reproductive age woman by the proportion of reproductive age females in the population (*w*) gives a measure of the probability of birth or birth rate independent of age structure effects with the same unit of measurement as the birth rate. In other words

$$f = w * (TFR/35)$$

It may be noticed that f is essentially a scalar multiple of TFR.

On the other hand, the life table death rate is a measure of mortality which is independent of the age structure of the population. It can therefore be taken as the measure of the death rate independent of age structure effects. The life table death rate is the reciprocal of the expectation of life at birth (e_0). Thus, the risk of death or death rate independent of age structure effects may be estimated as

$$l = 1/e_0.$$

Data

The present analysis is based on the estimates and projections of population of India based on the latest, 2015 revision, of the world population prospects prepared by the United Nations Population Division (United Nations, 2015). The preparation of each new revision of the world population prospects involves two distinct processes. The first process is related to the incorporation of new information about the demography of each country or area of the world and, in some cases, a reassessment of the past. The second process, on the other hand is related to the formulation of detailed assumptions about future paths of fertility, mortality and international migration, again for every country or area of the world (United Nations, 2015a).

The world population prospects 2015 provide estimates and projections for each country covering a 150-year time horizon, which is subdivided into past estimates (1950-2015) and future projections (2015-2100). United Nations Population Division has prepared eight variants of population projections for each country on the basis of different assumptions about the future trajectories of the factors that influence population growth - fertility, mortality and migration. The approach adopted for the purpose of projection is the most commonly used component projection method which requires that the components of population change are projected in advance. The method actually involves calculation of the effect of assumed future patterns of fertility, mortality, and migration on a population at some given point in the future (Preston et al, 2001).

The underlying assumption in the population projections prepared by the United Nations Population Division is that both fertility and mortality will continue to decrease in future also. In case of future course of fertility, three assumptions - medium decrease, slow decrease and fast decrease - have been made. Corresponding to the three fertility assumptions, the variants - medium variant, high variant and low variant - of population projections are prepared by the United Nations. Under the slow fertility decrease assumption, fertility is projected to remain 0.5 children above the medium fertility decrease over most of the projection period. On the other hand, under the fast fertility decrease assumption, fertility is projected to remain 0.5 children below the medium fertility decrease over most of the projection period. By contrast, only one assumption has been made about the future course of mortality. The future course of fertility and mortality has been based on the application of probabilistic projection methods. Detailed projection methodology adopted by the United Nations Population Division has been described elsewhere (United Nations, 2015a).

In the present analysis, we use the medium variant of the population projection for India prepared by the United Nations Population Division to analyse the demographic components of the projected population growth during the period 2015 through 2100. The medium variant of the projected population increase is termed by the United Nations Population Division as the most likely. It may be pointed out that the projected growth of the population of the country is contingent upon the projected decrease in the levels of fertility and mortality.

Results

a. Future Population Growth in India. Key indicators of the future population growth in India during 2015 through 2100 as revealed through the medium variant of population projections prepared by the United Nations Population Division are presented in table 1. These projections suggest that India's population will continue to increase till 2068 and will decrease subsequently. Between 2015 and 2068, India's population is the most likely to increase by very close to 34 per cent which means that between 2015 and 2068, around 443 million people are likely to be added to the population of the country in 2015. After 2068, the population of the country will start decreasing so that, by 2100, the population of the country will decrease to almost 1660 million. This means that between 2068 and 2100, the population of the country will decrease by 94 million so that India's population in 2100 is the most likely to be higher by close to 27 percent of the population in 2015. These projections are based on the assumption that the country will achieve the replacement fertility sometime during 2030-35 and then the total fertility rate will continue to decrease till 2080-85 to reach an all time low of 1.792 and then will increase marginally to almost 1.80 during 2095-2100. On the other hand, it is also assumed that the expectation of life at birth in the country will increase steadily from around 69 years during 2015-20 to almost 85 years during 2095-2100.

Projected trend in the natural population growth rate is presented in table 2 which suggest that the average annual population growth rate in the country will continue to decrease throughout the period under reference. It is the most likely that the average annual population growth rate in the country will turn negative during 2070-75 only and will continue to decrease till 2100. It is also projected that both age independent birth rate and age independent death rate will continue to decease throughout the period under reference. The decrease in the age independent birth rate will however be faster than the decrease in the age independent death rate.

Table 2 also suggests that the age structure effects will inflate the age independent birth rate by around 11 percent during 2015-20. The inflating effect of the age structure on the age independent birth rate will however tend to decrease and will turn negative during 2055-60 so that instead of inflating, age structure effects will start deflating the age independent birth rate. The age structure effects will continue to decrease till 2070-75 but will increase marginally after 2075. However, age structure effects will continue to deflate the age independent birth rate throughout the period 2055-2100.

On the other hand, age structure effects are projected to deflate the age independent death rate by almost 50 percent during 2015-20. However, the deflating effect of the age structure on the age independent death rate is projected to decrease with time so that during 2095-2100, the deflating effect will be reversed so that instead of deflating, the age structure will inflate the age independent death rate. The decrease in the deflating effect of the age structure on the age independent death rate is a reflection that the age structure of the population will get increasingly older with time.

Table 3 decomposes the change in the natural population growth rate into the change in the age independent birth rate, change in the age independent death rate, change in the age structure effects on the birth rate and the change in the age structure effects on the death rate. It may be noticed that a decrease in the age independent birth rate and age structure effects on the birth rate decreases the natural population growth rate while a decrease in the age independent death rate and the age structure effects on the death rate increases in natural population growth rate. The table suggests that primary drivers of the decrease in the natural population growth rate will be the decrease in the age independent birth rate or the probability of a birth and the increase in the age structure effects on the death rate. On the other hand, the decrease in the age independent death rate will tend to marginally slow down the decrease in the natural population growth rate.

Table 4 presents the projected change in the net addition to the population in different 5-years periods. For example, it is projected that the net addition to the population during the period 2020-25 will be around 5 million less than the change in the net addition to the population during the period 2015-2020. his change in the net addition to the population can be decomposed into the change attributed to i) the change in the size of the population; ii) the change in the age independent birth rate; iii) the change in the age independent death rate; iv) the change in the age structure effects on birth rate; and v) the change in the age structure effects on death rate. Table 4 suggests that the change in the age independent birth rate, the change in the age structure effects on the birth rate and the change in the age structure effects on death rate will contribute to decrease the net addition to the population. On the other hand, change in the age independent death rate and the change in the size of the population will tend to increase the net addition to the population.

Table 4 also suggests that the net addition to the population of the country is projected to decrease by more than 102 million during the period 2015 through 2100. During the period 2015-20, the net addition to the population of the country is projected to be around 80 million. This means that during the period 2095-2100, the net addition to the population of the country will be around -23 million or the population of the country will decrease by around 23 million during this period. This projected decrease in the net addition to the population is attributed to a projected decrease of 63.9

million (62 percent) as the result of the decrease in the age independent birth rate; a projected decrease of 56.4 million (55 percent) as the result of the change in the age structure effects on the death rate; a projected decrease of 13.8 million (13 percent) as the result of the change in the age structure effects on the birth rate; a projected increase of 16.1 million (16 percent) as the result of the increase in the size of the population; and a projected increase of 15.6 million (15 percent) as the result of the decrease in the age independent death rate. The projects decrease in the net addition of the population as the results of the decrease in the age independent birth rate, age structure effects on the birth rate and the age structure effects on the death rate will be around 134 million. On the other hand, the projected increase in the net addition to the population as the results of the increase in the size of the population and as the result of the decrease in the age independent death rate will be around 32 million so that the decrease in the net addition to the population will be around 102 million during the period under reference.

Alternatively, the intrinsic population growth rate - the difference between the age independent birth rate and the age independent death rate - is projected to decrease from 2.755 per 1000 during 2015-20 to -2.296 during 2095-2100. On the other hand, the natural growth rate accounted by the age structure of the population - the difference between age structure effects on birth rate and age structure effects on death rate - is projected to decrease from 0.605 per 1000 to -0.034 during this period. The intrinsic population growth rate is projected to turn negative during the period 2040-45 but the natural population growth rate accounted by the population age structure is projected to turn negative during the period 2090-95 only (Table 3).

In other words, the decrease in the intrinsic growth rate will result in a decrease of around 48 million in the net addition to the population during the period under reference. On the other hand, the decrease in the growth rat attributed to the change in age structure of the population will result in a decrease of around 70 million in the net addition to the population during so that the decrease in the natural growth rate will result in a decrease of around 118 million in the net addition to the population. This means that during 2095-2100, the population of the country will decrease by about 39 million. However, the increase in the size of the population will account for an increase of about 16 million in the net addition to the population so that the actual decrease in population during 2095-2100 will be of the order of around 23 million or average annual decrease of around 4.6 million per year (Table 4).

Finally, it is projected that India's population will increase by around 375 million between 2015 and 2100 or by around 28.6 percent. This increase will be the result of a decrease of around 553 million as the result of the decrease in the intrinsic growth rate resulting from the decrease in the age independent birth rate and the age independent death rate; a decrease of 645 million as the result of the decrease in the growth rate attributed to the change in the age structure of the population reflected through the age in the age structure effects on the birth rate and the death rate; and an increase of around 1572 million as the result of the increase in the size of the population (Table 5). In other words, the decrease in the age independent birth rate or the total fertility rate and the decrease in the age independent death rate or the increase in the expectation of life at birth will contribute towards a decrease in the size of the population stock of the country in the years to come. Similarly, changes in the age structure of the population, as reflected through the age structure effects on birth rate and death rate will also contribute towards a decrease in the size of the population stock of the country. However, these decreasing effects will be countered by the effects attributed to the increase in the size of the population. As the result, the population of the country is projected to increase by around 443 million between 2015 and 2070. After 2070, the population of the country will start decreasing so that the increase in population will reduce to 345 by 2100.

Conclusions

This paper has attempted to quantify the contribution of the demographic drivers of the projected change in the population stock in India during the period 2015-2100. If it is assumed that the populations tock is closed to migration, then, it is well known that the change in the population stock over time is determined by the initial size of the population stock, changes in the levels of fertility and mortality and changes in the age structure of the population stock. However, the population transition theory does not provide estimates of the relative contribution of the change in different components that determine the population stock to the change in the population stock. The present analysis shows that the projected increase in India's population in the years to come will be driven largely by a very large size effect, although both fertility and mortality levels and age structure effects on birth and death rates will tend to decrease instead increase the population of the country. The analysis presented here is based on the medium variant projection of India's population prepared by the United Nations Population Division and, therefore, is subject to future trajectory of fertility and mortality which are at best uncertain. As such, results presented here are contingent upon the realisation of the assumptions made by the United Nations Population Division in projecting India's population.

References

Andreev K, Kantorová, Bongaarts J (2013) Demographic components of future population growth. New York, United Nations. Population Division. Technical Paper No. 2013/3.

Bongaarts J (1994) Population policy options in the developing world. *Science* 263:2-7.

Bongaarts J (2009) Human population growth and the demographic transaction. *Philosophical Transactions of the Royal Society B* 354:2985-2990.

Bongaarts J, Bulatao RA (1999) Completing the demographic transition. *Population and Development Review* 25(3):515–529.

Chaurasia Alok Ranjan, Gulati SC (2008) *India: The State of Population 2007*. New Delhi, National Population Commission and Oxford University Press.

Chesnais J (1979) L'effet multiplicatif de la transition démographique. *Population* 36(6): 1138-1144.

Chesnais J (1986) *La transition démographique: Etapes, formes, implications économiques*. Cahier INED No. 113. Paris, Presses Universitaires de France.

Chesnais J (1990) Demographic transition patterns and their impact on the age structure. *Population and Development Review* 16(2): 327-336.

Frejka T (1973) *The Future of Population Growth: Alternative Paths to Equilibrium.* New York, John Wiley.

Frejka T (1981) Long-term prospects for world population growth. *Population and Development Review* 7(3):489-511.

Horiuchi (1991) Measurement and analysis of cohort size variations. *Population Bulletin of the United Nations*, 30: 106-124.

Kitagawa EM (1955) Components of a difference between two rates. *Journal of the American Statistical Association* 50(272):1168-94.

Keyfitz N (1977) On the momentum of population growth. *Demography* 8(1): 71-80.

Preston SH, Heuveline P, Guillot M (2001) *Demography. Measuring and Modeling Population Processes.* Oxford, Blackwell Publishers.

Schoen R (2002) Mathematical models in demography and actuarial mathematics. University Park, Pennsylvania State University, Population Research Institute. Working Paper No. 02-07.

United Nations (2015) *World Population Prospects. The 2015, Key Findings and Advance Tables*. New York, Department of Economic and Social Affairs. Population Division.

United Nations (2015a) *World Population Prospects. The 2015 Revision, Methodology of the United Nations Population Estimates and Projections*. New York, Department of Economic and Social Affairs. Population Division.

Vallin J (2006) Europe's demographic transition 1740-1940. In G Caselli, J Vallin, Wunsch G (eds) *Demography: Analysis and Synthesis*. New York, Academic Press.

Table 1

Projected population growth in India 2015-2100

Medium variant of 2015 revision of UN projections

Year	Population (Million)	CBR (0/00)	CDR (0/00)	TFR	E_0 (Years)	W(15-49) (Million)
2015	1311.051					336.738
2020	1390.745	19.09	7.28	2.34	69.08	358.407
2025	1465.370	17.76	7.31	2.23	70.50	376.162
2030	1533.250	16.51	7.46	2.14	71.72	387.873
2035	1592.702	15.28	7.67	2.06	72.88	394.683
2040	1642.840	14.16	7.96	1.99	73.94	397.787
2045	1684.493	13.32	8.31	1.94	74.93	398.534
2050	1718.017	12.65	8.71	1.89	75.87	395.969
2055	1743.760	12.06	9.09	1.86	76.86	390.339
2060	1761.218	11.50	9.51	1.83	77.79	383.316
2065	1770.418	11.02	9.98	1.82	78.66	376.788
2070	1772.628	10.62	10.37	1.80	79.61	368.540
2075	1768.328	10.31	10.80	1.80	80.48	359.012
2080	1758.801	10.07	11.15	1.79	81.36	348.724
2085	1744.868	9.86	11.45	1.79	82.21	338.469
2090	1727.988	9.68	11.62	1.79	83.13	328.787
2095	1708.251	9.52	11.82	1.79	83.95	319.394
2100	1685.603	9.39	12.06	1.80	84.64	310.223

Source: United Nations (2015)

Table 2

Projected trend in natural population growth rate, age independent birth rate, age independent death rate and age structure effects on the birth rate and age structure effects on the death rate in India 2015-2100.

Period	*r* Natural population growth rate (0/00)	*f* Age independent birth rate (0/00)	*l* Age independent death rate (0/00)	*ab* Age structure effects on birth rate (0/00)	*ad* Age structure effects on death rate (0/00)
2015-20	11.804	17.230	14.476	1.1076	0.5030
2020-25	10.455	16.400	14.184	1.0829	0.5150
2025-30	9.057	15.549	13.944	1.0621	0.5348
2030-35	7.609	14.713	13.722	1.0388	0.5593
2035-40	6.199	13.922	13.525	1.0169	0.5884
2040-45	5.008	13.242	13.346	1.0057	0.6226
2045-50	3.941	12.622	13.181	1.0021	0.6606
2050-55	2.975	12.059	13.011	1.0002	0.6984
2055-60	1.992	11.554	12.854	0.9955	0.7398
2060-65	1.042	11.165	12.713	0.9870	0.7848
2065-70	0.249	10.841	12.562	0.9798	0.8257
2070-75	-0.486	10.539	12.425	0.9783	0.8688
2075-80	-1.081	10.274	12.291	0.9801	0.9072
2080-85	-1.591	10.038	12.164	0.9827	0.9417
2085-90	-1.944	9.836	12.030	0.9840	0.9662
2090-95	-2.298	9.665	11.911	0.9848	0.9920
2095-2100	-2.669	9.519	11.815	0.9866	1.0208

Source: Author’s calculations based on table 1.

Table 3

Decomposition of the change in the natural population growth rate in India 2015-2100

Period	∇*r*	∂*f*	∂*l*	∂*ab*	∂*ad*	∂*i* = ∂*f* - ∂*f*	∂*a* = ∂*ab* - ∂*ad*
	0/00	0/00	0/00	0/00	0/00	0/00	0/00
2015-20/20-25	-1.349	-0.91	-0.149	-0.415	0.173	-0.761	-0.588
2020-25/25-30	-1.398	-0.913	-0.126	-0.333	0.278	-0.787	-0.611
2025-30/30-35	-1.448	-0.877	-0.121	-0.353	0.339	-0.756	-0.692
2030-35/35-40	-1.410	-0.814	-0.113	-0.313	0.396	-0.701	-0.709
2035-40/40-45	-1.191	-0.688	-0.108	-0.152	0.46	-0.580	-0.612
2040-45/45-50	-1.066	-0.623	-0.106	-0.047	0.503	-0.517	-0.550
2045-50/50-55	-0.967	-0.564	-0.115	-0.024	0.495	-0.449	-0.519
2050-55/55-60	-0.982	-0.503	-0.113	-0.055	0.537	-0.390	-0.592
2055-60/60-65	-0.95	-0.386	-0.108	-0.097	0.575	-0.278	-0.672
2060-65/65-70	-0.793	-0.319	-0.122	-0.079	0.517	-0.197	-0.596
2065-70/70-75	-0.735	-0.296	-0.116	-0.017	0.538	-0.180	-0.555
2070-75/75-80	-0.595	-0.26	-0.119	0.02	0.474	-0.141	-0.454
2075-80/80-85	-0.51	-0.231	-0.117	0.026	0.422	-0.114	-0.396
2080-85/85-90	-0.353	-0.199	-0.128	0.014	0.297	-0.071	-0.283
2085-90/90-95	-0.353	-0.169	-0.116	0.008	0.309	-0.053	-0.301
2090-95/95-2100	-0.372	-0.144	-0.097	0.017	0.342	-0.047	-0.325
2015-20/95-2100	*-14.473*	*-8.075*	*-2.027*	*-1.618*	*6.807*	*-6.022*	*-8.455*

Source: Author's calculations.

Table 4

Decomposition of the change in the natural population growth rate in India 2015-2100

Period	Change in the net addition to the population	Change in the net addition to the population attributed to						
		Change in population size	Change in age independent birth rate	Change in age independent death rate	Change in age structure effects on birth rate	Change in age structure effects on death rate	Change in intrinsic growth rate	Change in growth rate attributed to age structure
2015-20/20-25	-5.070	4.299	-6.319	-2.885	-1.034	1.198	-5.286	-4.083
2020-25/25-30	-6.745	3.481	-6.678	-2.439	-0.922	2.031	-5.756	-4.469
2025-30/30-35	-8.428	2.657	-6.715	-2.700	-0.928	2.598	-5.788	-5.297
2030-35/35-40	-9.314	1.895	-6.469	-2.490	-0.898	3.149	-5.57	-5.638
2035-40/40-45	-8.486	1.288	-5.640	-1.245	-0.888	3.776	-4.753	-5.021
2040-45/45-50	-8.128	0.842	-5.236	-0.396	-0.894	4.232	-4.342	-4.628
2045-50/50-55	-7.783	0.513	-4.836	-0.203	-0.989	4.245	-3.847	-4.448
2050-55/55-60	-8.284	0.269	-4.383	-0.476	-0.980	4.673	-3.403	-5.149
2055-60/60-65	-8.258	0.101	-3.392	-0.855	-0.947	5.059	-2.445	-5.914
2060-65/65-70	-6.991	0.018	-2.822	-0.695	-1.078	4.571	-1.744	-5.266
2065-70/70-75	-6.509	0.001	-2.620	-0.149	-1.027	4.768	-1.593	-4.917
2070-75/75-80	-5.228	0.027	-2.294	0.174	-1.051	4.186	-1.243	-4.012
2075-80/80-85	-4.405	0.078	-2.029	0.225	-1.029	3.708	-1.001	-3.483
2080-85/85-90	-2.946	0.136	-1.732	0.119	-1.120	2.590	-0.612	-2.471
2085-90/90-95	-2.858	0.194	-1.456	0.067	-1.002	2.666	-0.454	-2.598

Period	Change in the net addition to the population	Change in the net addition to the population attributed to						
		Change in population size	Change in age independent birth rate	Change in age independent death rate	Change in age structure effects on birth rate	Change in age structure effects on death rate	Change in intrinsic growth rate	Change in growth rate attributed to age structure
2090-95/95-2100	-2.910	0.263	-1.231	0.148	-0.827	2.918	-0.404	-2.77
2015-20/95-2100	*-102.342*	*16.062*	*-63.852*	*-13.798*	*-15.613*	*56.367*	*-48.239*	*-70.165*

Source: Author's calculations.

Table 5

Decomposition of the increase in population of India: 2015-2100

Period	Increase in population	Increase attributed to population size	Increase attributed to age independent birth rate	Increase attributed to age structure effects on birth rate	Increase attributed to age independent death rate	Increase attributed to age structure effects on death rate	Increase attributed to intrinsic growth rate	Increase attribute to growth rate accounted by age structure
2015-20	79.694	79.694	79.694	79.694	79.694	79.694	0	0
2020-25	74.624	83.994	73.375	76.809	78.661	80.893	-5.286	-4.084
2025-30	67.879	87.474	66.697	74.371	77.739	82.924	-11.042	-8.553
2030-35	59.452	90.131	59.982	71.671	76.811	85.521	-16.829	-13.85
2035-40	50.139	92.026	53.514	69.182	75.913	88.67	-22.399	-19.488
2040-45	41.652	93.314	47.873	67.936	75.025	92.446	-27.152	-24.51
2045-50	33.525	94.156	42.637	67.541	74.131	96.678	-31.494	-29.137
2050-55	25.743	94.669	37.801	67.338	73.142	100.923	-35.341	-33.585
2055-60	17.459	94.937	33.418	66.862	72.162	105.596	-38.744	-38.734
2060-65	9.201	95.038	30.026	66.007	71.215	110.655	-41.189	-44.648
2065-70	2.21	95.057	27.204	65.312	70.137	115.226	-42.933	-49.914
2070-75	-4.3	95.057	24.584	65.163	69.11	119.994	-44.526	-54.831
2075-80	-9.528	95.084	22.29	65.337	68.059	124.18	-45.769	-58.843
2080-85	-13.932	95.163	20.261	65.562	67.03	127.888	-46.769	-62.326
2085-90	-16.879	95.299	18.529	65.681	65.91	130.478	-47.381	-64.797
2090-95	-19.737	95.493	17.073	65.748	64.908	133.143	-47.835	-67.395

Period	Increase in population	Increase attributed to population size	Increase attributed to age independent birth rate	Increase attributed to age structure effects on birth rate	Increase attributed to age independent death rate	Increase attributed to age structure effects on death rate	Increase attributed to intrinsic growth rate	Increase attribute to growth rate accounted by age structure
2095-2100	-22.647	95.757	15.842	65.896	64.081	136.061	-48.239	-70.165
2015-2100	*374.552*	*1572.343*	*670.8*	*1166.109*	*1223.728*	*1810.972*	*-552.928*	*-644.863*

Source: Author’s calculations.