Title: Economic Returns of Family Planning and Fertility Decline in India, 1991 to 2061

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Abstract

The investment in family planning [FP] is an investment in lifetime returns. Evidence in the global context shows that FP is the second-best buy in terms of return on investment [ROI] among the 17 Sustainable Development Goals (SDGs). A number of studies make a strong economic case for the ROI of FP, but the wide-ranging estimates also create confusion using different methodologies. To address this confusion, we used three modules of the Spectrum Policy Modelling System, namely, DemProj, FamPlan and RAPID, to estimate the cumulative benefits of FP investments for India from 1991 to 2016 and projected them until 2061 with four different scenarios of fertility levels. With a scenario of a total fertility rate (TFR) of just below replacement level (TFR of 1.8) at the goal post (2061), the estimates of cost-benefit cumulative ratios or investments in lifetime returns suggest that the investment of every rupee was benefited by a return of 4 rupees in 1991, which rose to 45 rupees in 2016 and will rise to 95 rupees by 2030, 235 rupees by 2045 and 628 rupees by 2061. Thus, the findings suggest that India will have greater elasticity of family planning investments to lifetime economic returns compared to the world average (cost-benefit ratio of $1: $120). The study also found that the period from 2016 to 2061 is a window of opportunity for the country to reap a demographic bonus as a consequence of demographic transitions, especially fertility decline. Although different scenarios of TFR levels at the goal post (2061) show different levels of lifetime returns of FP, TFR <1.8 will be counterproductive and will reduce the potential benefits. With a comprehensive approach, if the country focuses more on improving the quality of FP services and reducing the unmet need for FP to enhance reproductive health and expand opportunities for education and employment for both women and men, then it can improve its potential to reap more benefits than those reported.

1. Introduction

The latest interplay between population growth and economic development has long been investigated at global and regional scales. During 1960-1990, the performance of economic growth in Asian countries, particularly East Asian countries, is largely influenced by demographic factors (Bloom and Williamson 1998). Family planning [FP] is one of the most successful development interventions in the past 50 years. It not only reduces the level of fertility at the aggregate level in a country but also supports the development of healthier and wealthier families in the long run (PRB, 2010). Thus, FP is unique in its range of potential benefits, encompassing economic development, maternal and child health, educational advancement, and women's empowerment. Research shows that with high-quality voluntary FP programmes, governments are able to reduce fertility and produce large-scale improvements in health, wealth, human rights, and education (Bongaarts et al., 2012). Fertility declines and resulting demographic changes influence economic growth through labour supply, the accumulation of human capital, women's empowerment and savings. Previous evidence has indicated that an increase in the working-age population raised the income per capita because the productivity of the workers was constant and the proportion of youth dependants was reduced (Bloom and Williamson, 1997, Bloom *et al.,* 2001; Mason *et al.,* 2010). Fertility decline is also often associated with an increase in women's paid labour force participation and a reduction in additional expenditures for children's education and health care, thus allowing families to boost their savings, which results in increased investments and income and reduced poverty (Mammen and Paxson, 2000; Lee *et al.*, 2000; Bloom *et al.*, 2007).

Despite having a long history, the evidence for the returns of FP and fertility decline has been rather weak in developing countries, particularly with respect to the interrelation among FP, fertility and economic growth. Such a relationship has no surprising elements, but no systematic documentation of empirical evidence is available to reiterate the benefits of FP to policy-makers in the developing world. A lack of evidence on the cost-effectiveness of the FP programme also leads to a persistent reduction in political interest to invest in the core FP programme in developing countries, especially since the late 1990s (Bongaarts et al., 2012). In particular, countries that have achieved or that are about to achieve replacement level fertility are gradually reducing funds for the FP programme, although a large share of the population in the reproductive age group have an unmet need for FP. In the context of this high need for FP, this is a high time to highlight the multi-sectoral impacts of the FP programme and thereby measure their socioeconomic returns among the countries that are close to reaching replacement level fertility. Like the East Asian Tigers, India has tremendous potential to reap demographic windows of opportunity in the next few decades, provided that a favourable environment is created. In the following section, we have briefly presented silent features of the unique story of India's FP programme and the trajectory of fertility decline.

1.1. Family Planning and Fertility decline in India

Since its historical initiation in 1951, the official FP programme in India has been considered both unique and the first of its kind in the world. Currently, the country is passing through a crucial stage of demographic transition. Due to the concerted efforts in FP programmes over more than six decades, the total fertility rate (TFR) in the country declined from 6 in the 1950s to 2.2 in 2016 (James and Goli, 2017; Office of RGI, 2018). India and the majority of its states are close to reaching replacement level fertility by 2020, while its core FP expenditure is already at a record low and contraception prevalence is decreasing. India is only now entering the stage of demographic dividends, when the population in the working-age group is reaching its highest peak. Previous studies have shown that thewindow of opportunity for the country began in 2015 and will continue until 2045, but moderate opportunities will be observed until 2061 (Goli and Pandey, 2010).

Concerted programme efforts have also yielded tremendous returns regarding fertility decline (Srinivasan *et al*., 2007), although the implementation approach has been criticised (James and Goli, 2017). India has been achieving a much more rapid fertility decline, which is unconventional compared to the pattern of fertility decline in developed and other developing countries, where states have typically taken much longer to achieve replacement level fertility than the time that has been observed in the Indian context. Many of the Indian states—especially most of the southern, western and far-eastern states—have fallen below the "replacement level" fertility rates (James and Nair, 2005; Kulkarni, 2011; Arokiasamy and Goli, 2012). Currently, high fertility is not an issue in the majority of the states of India; therefore, family planning is not receiving the same magnitude of attention that it has received in the past. Along with the fertility decline, if FP also has an impact on public health and socioeconomic outcomes, then it is a matter of great interest for governments. In particular, both national governments and international organisations are interested in more information on the returns of decades of investments in FP.

2. Family Planning, Fertility Decline and Economic Returns: Pathways

Figure 1 illustrates the relationship between fertility decline and economic outcomes through micro- and macro-economic pathways. FP is directly associated with reduced childbearing and healthy birth spacing at the household level. As a result, the overall fertility declined at the macro level. At the household level, when women delay the age at childbearing, they can invest more years into their education and may obtain better job opportunities and higher incomes (Darroch and Singh, 2011; Longwe and Smits, 2011; Birdsall and Chester, 1987). FP directly reduces the burden of household out-of-pocket health care and other expenditures due to the reduced number of children and reduced chances of illness. In turn, it increases household savings (Canning and Schultz, 2012; WHO, 2013; Bailey, 2006). In the long run, the educational status of children whose parents engaged in FP is higher than that of their counterparts (Sonfield *et al.,* 2013; Canning and Schultz, 2012; Cleland *et al.,* 2006), which also led to higher income and wealth of the household.

At the macro level, as the fertility level declined over time, the share of the working-age population increased and the number of child dependants decreased. Even if productivity remains the same, the per capita income increases because of reduced child dependency (Mason *et al.,* 2010). At the national level, due to the reduced number of child dependants, expenditures on dependants in terms of welfare schemes can be saved. On the other hand, national savings and the savings of the working-age population are later converted into capital investment, which increases the GDP per capita (Mason *et al.,* 2010; Lee *et al.*, 2000).

FP directly gives the option to couples or women to have a desired number of children with a healthy timing and spacing between births. Indirectly, with the adoption of FP, women can spend more years pursuing their education, obtain better opportunities in the labour market, and save resources by spending less on more children and spending more on their existing children. In turn, the economic status of the household improves in the long run. On the other hand, the government may save additional resources on welfare schemes due to the reduced number of children, which increases national savings. Due to declining fertility over a longer period of time, the age structure of the population has been changing, and the working-age population has increased. Such an increase in the share of the working age population has the potential to contribute to the GDP in a country. In the following sections, we have described the key pathways that create a favourable environment to reap demographic bonuses from the demographic transition fostered by FP use and a fertility decline.

2.1.Women's Education and Employment

Previous studies suggest that the adoption of FP allows women to improve their level of education and reduce their risk of unintentional pregnancy, thus reducing the number of births and facilitating a more favourable timing of childbearing, which further contributes to greater participation of women in the workforce and in higher-quality jobs (Darroch and

Singh, 2011; Longwe and Smits, 2011; Birdsall and Chester, 1987). Spending more hours on their work further reduces fertility, which results in reduced child dependency and increased earnings, savings and assets among women and may result in women's empowerment (Canning and Schultz, 2012; WHO, 2013; Bailey, 2006). According to Goldin and Katz (2000, 2002), the use of oral pills among unmarried minors enables women to progress in their career, avoiding childbearing before marriage and decreasing the incidence of shotgun marriages, while another study found evidence of delaying pregnancy within marriage and increasing educational and professional advancement among women (Edlund and Machado, 2009). It has also been found that the gender gap in income decreases with increasing contraceptive use through the empowerment of women (Bailey, 2011; Bailey *et al.,* 2012).

2.2. Child Education, Employment and Economic Status

Time-series and longitudinal studies at the macro and micro levels have documented that short birth spacing and larger family size are linked with lower parental investment in their children. Consequently, this lower parental investment influences children's mental and behavioural development and educational achievement, whereas the adoption of family planning increases the length of children's schooling, wages, and income and promotes college completion and labour force participation. As a result, parental adoption of FP for a longer period of time reduces poverty and hunger and increases income among their children (Sonfield *et al.,* 2013; Canning and Schultz, 2012; Cleland *et al.,* 2006).

2.3. Economic Savings

FP benefits are not restricted to individual and household levels, but they are evident even at the macro level. The previous evidence reveals that the ratio between the benefit and cost of the FP programme is 26:1. Thus, a parent can save the cost of unwanted child care and other expenses (Campbell, 1968). Similarly, a major public expenditure can be saved by reducing expenditures on maternal and child health care and other welfare and social services, whereas another estimate suggested that approximately $1.5 billion per year can be saved, fulfilling the current unmet need for FP in the United States (Biggs et al., 2010; Darroch and Singh, 2011).

2.4. The Demographic Window of Opportunity

In addition to socioeconomic development at the micro and macro levels due to the adoption of FP, the change in the age structure of the population has the potential to contribute to the economy of a country once in a lifetime. During the demographic transition, in the declining fertility trend, the population in the child age group or the dependant population decreases, while the population in the working-age group increases. The decline in fertility also increases the population-dependent support ratio, which, in turn, accelerates the per capita income and savings for improved lifestyles in later life. The economic bonus of the demographic change is known as the "first demographic dividend". When the cohort in the working-age group reaches the older-age group with more capital, the rising capital-labour ratio is maintained through capital investment, which is considered the "second demographic dividend" (Mason *et al.,* 2010).

3. Previous Evidence and Approaches

In the previous section, it has been shown that family planning has direct and indirect effects on economic growth at the individual, household and national levels through savings, better education and job opportunity. In contrast, family planning may have macro-level economic benefits through declining fertility rates and population growth. Population growth and economic development are unfinished, long-debated issues in human history. In the macroeconomic model, the role of rising fertility rates and increasing population growth in the decay of earth's physical resources has long been a concern (Malthus, 1798). Later, in population and development studies, population growth and economic development have been widely debated. Many previous studies have assessed the relationship between fertility decline or population growth and economic development through the perspectives of macroeconomic, microeconomic and simulation approaches of analyses. Among the macroeconomic studies that have contributed to the literature on the relationship between population growth and economic development, Lee *et al.* (1988), Lewis (1954), Livi-Bacci (1998), Lucas (1997), Malthus (1798), Kuznets (1967), and Leff (1969) are considered novel. The pioneering study by Kuznets (1967) showed a positive association between population growth and income growth by a broad grouping of countries around the world. Contrary to this view, Kelley (1988) suggested a spurious relationship between population growth and growth in income per capita and asserted that there is no clear unidirectional relationship between the growth of the population and the growth of the rate of savings, with the country as the unit of analysis. Furthermore, he argued that the evidence of a negative association is rather weak. The attention of scholars turned more towards an examination of this relationship after the advent of the growth regression models proposed by Barro (1991), Mankiw (1992), Romer (1990) and Lucas (2000). The classical growth regression models addressed the population growth, labour force growth or changes in dependency ratios as right-hand-side variables and the growth of income per capita or economic growth (savings rates, etc.) as left-hand-side variables. A study by Kelley and Schmidt (2005) on the dependency and Solow effects regressed the income growth rate on the population growth rate (Solow effect) and the growth rate of the working-age population (dependency effect) and found a positive correlation. Using a panel of cross-country regression models, Bloom and Canning (2008) reported a positive and significant coefficient by regressing income per capita growth on working-age population growth. Here, we could say that FP and fertility decline contribute to a decrease in population growth, which eventually contributes to a decrease in child dependency ratios and a rise in the working-age population and provides a window of opportunity to reap a demographic dividend; otherwise, they are referred to as economic returns.

The methodological issues encountered in macro models require extra caution in the interpretation of results. Hence, for a more policy-inclined view, one needs to capture the interrelationship at the household level to appeal to the outreach of the benefits of a particular programme and policy intervention. Some pioneering studies addressing the long-term effects of contraception in randomised control trials designs in Matlab, Bangladesh, have found that reductions in fertility levels (the number of children avoided due to the utilisation of contraception) improve the health, economic earnings and household assets of women as well as their children (Joshi and Schultz, 2007; Schultz, 2009). Similarly, a study evaluating the *Profamilia* programme in Colombia documented lower fertility in women in programme households than in women in control households and better social and economic conditions in programme households through an increase in women's educational status resulting from the postponement of marriage and first birth (Miller, 2010). In analysing the number of children and considering twins as an exogenous discrepancy, Rosenzweig and Zhang (2009) found a negative relationship between fertility level and educational attainment. Furthermore, they found a major disparity within and between the geographical periphery of the study area. In contrast, studies have also shown that there is no effect of fertility (number of children) on the quality of children (schooling, health) while controlling for the possible alterations arising because of twins and mixed-sex compositions of a number of children in the household (Angrist *et al.*, 2010).

Coale and Hoover (1958), who were considered the intellectual ancestors of modern eco-demographic models, analysed the effect of fertility on income per capita in the case of India. While reporting the significance of their study, they made three alternative population projections (high, medium and low) and projected the per capita income in all scenarios, finding a strong negative correlation between change in fertility level and change in income per capita. Enke (1971) proposed the more modern production model by considering the cases of high fertility (constant gross reproduction rate) and low fertility (drop in gross reproduction rate) and suggested an adverse impact of high population growth on the income per capita. The study by Mason *et al.* (2010) has shown a drop in fertility level with increasing years of schooling per child. Finally, in the more dynamic simulation model proposed by Ashraf *et al.* (2013), the authors have considered the different paths of population growth (i.e., physical capital accumulation, effective labour, returns on schooling and experience, childcare effects on labour supply) and have estimated economic outcomes. Furthermore, a recent study includes more channels, such as child health outcomes, savings due to changes in age structure and family planning programmes, in estimating the economic returns of fertility decline (Karra *et al.,* 2017).

4. The rationale of this Study

FP inherited a latent goal of stabilising the populations of countries to optimise the balance between the population and resources. It has not only reduced the impediments of economic progress but also stimulated multifarious returns for countries (Joshi and Schultz, 2007; Schultz, 2009; Miller 2010). The economic returns of the FP and fertility decline are so diverse that every single unit investment in the FP confers more returns than the cost of FP itself (Campbell, 1968; Biggs *et al.,* 2010; Sonfield *et al.*, 2013). The economic return of FP contributes to a lower investment of resources and money on life course events, such as costs associated with pregnancy, miscarriage, abortion, and delivery (Frost et al., 2014; PFI, 2018). Thus, investment in FP can be a useful tool in curtailing out-of-pocket expenditures as well as national savings incurred in the costs related to childbearing and rearing. Evidence from Bangladesh suggests that the families who received FP and Maternal and Child Health (MCH) services through the programme experienced greater health benefits in addition to larger incomes, higher levels of education and greater accumulation of wealth (Joshi and Schultz, 2007; Schultz, 2009).

Fertility decline is also often associated with an increase in women's paid labour force participation and a reduction in additional expenditures for children's education and health care, thus allowing families to boost their income and reduce poverty. Despite a long history of FP programmes in India, the assessment of the returns of FP and fertility decline on economic growth is very limited. This relationship has no surprising elements, but there is no systematic documentation of empirical evidence to reiterate FP benefits to policy-makers. The recent reluctance of the government of India to invest in FP is a consequence of the lack of strong advocacy for the benefits of FP (Government of India, 2011). Moreover, there is no adequate information on returns of decades of investments in FP programmes in India. A lack of this information has also led to poor advocacy for investments in FP programmes by population policy analysts to the states. Therefore, this is an important time to highlight the economic returns of FP and fertility decline in India.

As mentioned earlier, fertility decline improves economic growth through the labour supply, accumulation of human capital and savings. In addition to the labour supply and savings, the role of human capital in reaping the demographic dividend in a country is inevitable. The investment in human capital, particularly education and health, may enhance a country's capacity to grasp opportunities for demographic advantage (Prettner *et al.*, 2013). Thus, in addition to the economic returns of fertility decline, this study estimates the required educational and health infrastructure for the next several decades to reap the demographic dividend.

5. Data Inputs, Assumptions and Statistical Analyses

The data have been collected from different sources for the period 1991-2016. During this period, the estimates were interpolated when data were unavailable. Standard assumptions have been made for the projection of the estimates up to 2061. The DemProj, RAPID and FamPlan modules of the Spectrum suite were used to estimate and project the results. For the period of 2016-2061, four scenarios of fertility decline were assumed at different assumptions following the Gompertz curve. In 2061, the fertility levels are assumed to be TFR 2.1 (replacement level), TFR 1.8 (high variant) TFR 1.6 (medium variant), and TFR 1.4 (low variant). Separate estimates have been made for the different variants of fertility decline. For details, these data inputs, assumptions, and statistical approaches are given in Appendix 1.

6. Economic Returns of Family planning and Fertility Decline in India

The economic returns of FP and fertility decline have been estimated using the FamPlan and RAPID modules of the Spectrum suite (5.72), respectively. For both modules, the inputs and assumptions of different scenarios remain the same. The economic returns of FP were shown in terms of the cost of the FP programme and its benefits. At the same time, the returns of fertility decline are captured in GDP per capita.

6.1. Cost and benefits of family planning

The economic cost for the FP programme and benefits in terms of revenue have been described for the period 1991-2016 and 2016-2061 in this section. The cost of the FP programme has been increased from 537 million rupees in 1991 to 1631 million rupees in 2016 to reduce the fertility to the current level (Figure 1). In response, the benefits increased from 2.5 billion rupees in 1991 to 74 billion rupees in 2016 (Figure 2). During 1991-2016, the total cost for the FP programme was 6.7 billion rupees, while the benefit from the investment was 193 billion rupees. In other words, during the same period, the cost-benefit ratio increased from 1:5 in 1991 to 1:45 in 2016 (Figure 3). The cumulative cost-benefit ratio can be increased to 1:96 in 2030, 1:230 in 2045 and 1:609 in 2061 if fertility declines to the level of TFR 1.6, following the Gompertz curve (Table 1). In 2061, the cost-benefit ratio was projected to be the highest for the high variant of fertility (TFR 1.8). This may be because a fertility level that is lower than just below the replacement level for a longer time may increase the burden of the older population and consequently lower support ratios, which may result in a lower cost-benefit ratio from the FP programme.

6.2. Economic Returns of Fertility Decline

The economic returns of fertility decline are estimated by the gross domestic product (GDP), in total as well as per capita. The total GDP increased from 5 trillion in 1991 to 130 trillion in 2061, which is projected to rise to 492 trillion in 2030, 1531 million in 2045 and 3906 trillion in 2061 (Figure 4). The GDP per capita steadily increased from 6 thousand per person to 107 thousand per person during 1991-2016 (Figure 5). It can further increase to 2723 thousand per person in 2061 if the fertility level declines to TFR 1.6 in the same year (TFR 1.8: 2611 thousand per person; TFR 1.4: 2815 per person).

7. Requisite for Reaping the Demographic Dividend in India

In the next few decades, India has the demographic window of opportunity to reap the advantages of the large population in the working-age group. As mentioned earlier, education and health play an important role in taking advantage of demographic dividends (Prettner *et al.*, 2013). Therefore, the need for educational and health infrastructure is projected in this study for the next four decades and beyond.

7.1. Education

The number of school-age children and students was estimated to determine the requirements for teachers and schools. The required educational infrastructure for primary- and secondary-level students, particularly with respect to teachers and schools, was also projected.

7.1.1. School-age children and students in primary and secondary schools:

The school-age children and students in primary and secondary schools during 1991-2016 and 2016-2061 are described in this section. The number of primary school-age children increased from 105 million in 1991 to 112 million in 2012 and declined to 109 million in 2016 (Figure 6). The number may further decline to 66 million in 2061 if fertility is reduced to TFR 1.6 in the same year (TFR 1.8: 76 million; TFR 1.4: 57 million). Similarly, the students in the primary school increased from 88 million in 1991 to 129 million in 2011, and it may decline to 108 million in 2016 (Figure 7). Interestingly, during 2005-2011, the number of primary school students was higher than the number of school-age children. It is possible that the enrolment of a student in more than one primary school surpasses the gross enrolment ratio of more than 100%. It is projected that the gap between school-age children and students in primary school will be narrowed down and will eventually be zero in 2061. The school-age children in secondary schools increased from 89 million in 1991 to 110 in 2016 (Figure 8). The number of children is projected to be highest during 2018-2020; again, it will be reduced to 71 million in 2061 if the TFR declines to 1.6 in the same year (TFR 1.8: 80 million; TFR 1.4: 63 million). Similarly, the number of secondary students increased from 59 million to 97 million during 1991-2016 (Figure 9). It is projected that the gap between secondary school-age children and secondary students will be zero in 2061.

7.1.2. Teachers required in primary and secondary schools:

The estimated number of primary and secondary school teachers during 1991-2061 are presented in Figure 10. The results suggest that the number of primary school teachers have increased from 2 million to 4.7 million during 1991-2016. The estimated number of teachers required can gradually be increased to 5.1 million in 2061 to maintain the teacher-student ratio that is standard in developed countries. In 2061, the estimated number of required teachers for primary schools may vary from 5.9 million to 4.4 million for high (TFR 1.8) and low (TFR 1.4) variants of fertility projections, respectively. The required number of teachers for secondary schools increased from 1.85 million in 1991 to 3.6 million in 2016 (Figure 11) and is projected to increase further to 5.44 million in 2061 if the TFR were to decline to TFR 1.6 in the same year (TFR 1.8: 6.14 million; TFR 1.4: 4.86 million).

7.1.3. Primary and secondary schools required:

The required number of schools for the primary and secondary students are presented in Figure 12 and 13. The required number of primary schools has increased from 507 thousand to 775 thousand in 2010, and it reduced to 706 thousand in 2016 (Figure 12). The required number of primary schools may further be reduced to 429 thousand in 2061 if the fertility level declines to TFR 1.6 in that year (TFR 1.8: 498 thousand; TFR 1.4: 371 thousand). Similarly, approximately 267 thousand secondary schools were required in 1991, which increased to 572 thousand in 2016 (Figure 14). The number of secondary schools required is projected to be approximately 416 thousand in 2061 if the fertility rate decreases to TFR 1.6 (TFR 1.8: 470 thousand; TFR 1.4: 372 thousand).

7.2. Health

A few basic indicators of health infrastructure are estimated and projected for the requirement of a healthy population in India. These indicators include health personnel, health infrastructure, and annual health care expenditure, which are described in this section.

7.2.1. Required medical health personnel:

The required medical health personnel are estimated by the number of doctors and nurses in the hospitals. The required number of doctors was 0.39 million in 1991, which has been increased to 0.72 million in 2016 (Figure 15). Furthermore, the number of required doctors may be increased to 3.59 million in 2061 if the fertility rate declines to TFR 1.6 in the same year (TFR 1.8: 3.74 million; TFR 1.4: 3.47 million). Similarly, the number of required nurses increased from 0.33 million to 2.6 million during 1991-2016 (Figure 16). The number of required nurses can further be increased to 14.2 million in 2016 at the medium variant of fertility decline (TFR 1.8: 14.8 million; TFR 1.4: 13.7 million).

7.2.2. Required medical health infrastructure:

The medical infrastructure is estimated in terms of a number of hospitals and hospital beds required during 1991-2016 and 2016-2061. The number of hospitals has increased from 11.1 thousand to 13.5 thousand during 1991-2016 (Figure 17). Furthermore, the number of hospitals is required to increase by 25.8 thousand in 2061 if fertility declines to TFR 1.6 in that year (TFR 1.8: 26.9 thousand; TFR 1.4: 25.0 thousand). The required hospital beds have also increased from 803 thousand in 1991 to 594 thousand in 2016 (Figure 18). In addition, the number of hospital beds needs to increase to 778 thousand in 2061 in the medium variant of fertility decline (TFR 1.8: 881 thousand; TFR 1.4: 752 thousand).

7.2.3. Required annual recurrent health care expenditure:

The required annual recurrent health care expenditure is estimated for the period of 1991-2016 and 2016-2061. It increased from 0.1 million to 1.7 million during 1991-2016 (Figure 19). It may further increase to 42.5 million in 2061 if the fertility level declines to TFR 1.6 in the same year (TFR 1.8: 44.3 million; TFR 1.4: 41.1 million).

8. Conclusions and Policy Implications

Concerted efforts of the FP programme have yielded tremendous returns regarding fertility decline and its consequent economic returns. The fertility rate of many of the Indian states—especially that of most of the southern, western and far-eastern states—has fallen below replacement level. Along with fertility decline, if FP also has an impact on public health and socioeconomic outcomes, then in turn, the FP programme has direct or indirect bearing on economic outcomes. In particular, both national governments and international organisations are interested in knowing the returns on decades of investments in FP. India has been achieving a much more rapid fertility decline, which is the unconventional compared to the pattern of fertility decline in developed countries, where states have typically taken much longer to achieve replacement level fertility than the time that has been observed in the Indian context. Currently, high fertility is not an issue in the majority of the states of India;

therefore, FP-related topics are not receiving as much attention as in the past, although after the London Summit of FP (2012), the FP programme has emphasised reaching women with unmet needs for FP (Government of India, 2014). However, the country still shows one of the highest unmet needs for FP in the world. With this background, this study may make a valuable contribution to the body of literature and policy analysis.

Our findings suggest that the FP programme and fertility decline have considerable effects on economic returns in India. Over time, the cost-benefit ratios of investing in the FP programme are expected to increase if the fertility rate declines to a certain extent. In particular, the cost-benefit ratio of the FP programme is expected to increase by hundreds of times, which is considerably higher than the benefits of other countries (Campbell, 1968; Biggs et al., 2010; Darroch and Singh, 2011). The findings of this study would help policy-makers in this country to emphasise the FP programme and thereby to achieve the SDGs. Moreover, to reap the demographic dividend in the country, a special focus on educational and health infrastructure is required. The estimates of the required educational and health infrastructure can be set as the benchmarks of infrastructural development for policy-makers in India.

The fertility decline is also substantially determined by the quality-quantity trade-off of the children, reducing old-age insecurities of parents and opportunity costs of mothers (Galor and Weil, 2000; Doepke, 2004). In our interpretation of the relationship between fertility decline and economic growth, the endogeneity of fertility decline due to economic growth is not taken into consideration. Furthermore, economic growth is the outcome of not only fertility decline but also other determinants, specifically, institutional factors such as efficient governance, a market-based open economy, investment in basic infrastructure and encouragement in total factor productivity (Karra *et al.,* 2017). Even if the fertility decline and the per capita GDP show a manifold increase during the next several decades, closing the gap between India other developed countries is beyond India's capacity. However, the findings from this study suggest that the investment in FP and the reduction in the fertility level can contribute substantially to economic growth in India and other developing countries. Importantly, the investment in the FP programme will address the issue of the unmet need for FP in India to improve reproductive health and secure the reproductive rights of women and girls in India.

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Appendix

1. Data Inputs, Assumptions and Analyses:

1.1 DemProj Module

Population Projections

Population projection is a scientific tool that integrates various components of change to project future population and composition. For the projection of the population of India from 1991 to 2061, the *DemProj* modules of the Spectrum suite of tools (version 5.72) have been used. The population of 1991 has been used as the base year for projection. The base year 1991 was chosen for two important reasons. First, it allows us to evaluate the validity and suitability of the model and the projected population for the years 2001 and 2011 with the respective population from the 2001 and 2011 census figures. Second, after the 1994 ICPD conference, the FP agenda shifted to the rights and welfare of women, and the agenda was expanded to encompass the advancement of women rather than the narrower FP goals only. The ICPD has brought a multitude of changes in health and reproductive outcomes, which have an undeniable impact on the future growth of the population. Thus, 1991 can be considered the foundation of both demographic and health perspectives in India. Considering these points, this study has collected the requisites of the projection exercise using the ***cohort-component method,*** based on the 1991 census as the base year. Moreover, our projection model is not confined until the time population is claimed to be increasing but rather extends to the time horizon of the complete dividend per se. It is well established that the country is undergoing unconventional demographic and socioeconomic transitions with less corroboration between the two perspectives, and hence, different states are placed in a different phase of transition.

The population at the Base Year

The age-sex distribution has been acquired as the base year population from the 1991 population census. To provide a high-quality base year, population five-year age-sex data are adjusted for non-sampling error (age not stated). Members of the population who have not stated their correct ages have been distributed uniformly across different age groups.

Total Fertility Rate

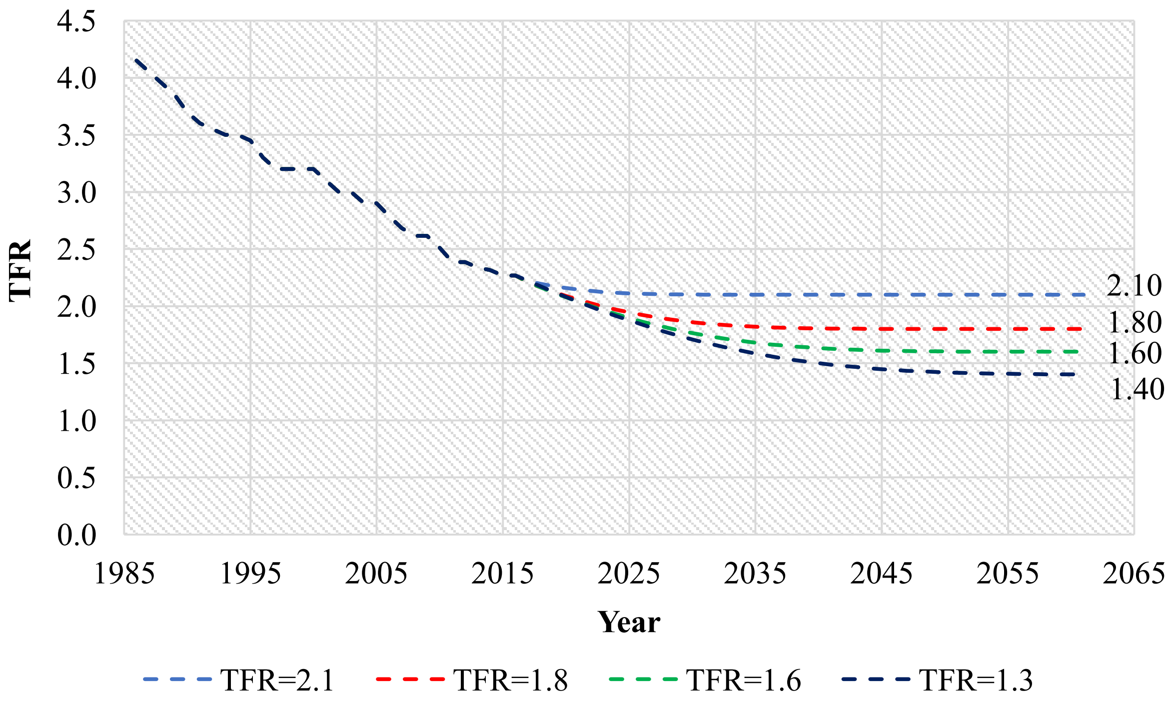
The trajectory of fertility in India is the most contested component in any projection. The endpoint of convergence of the TFR and subsequent endpoint has been mentioned in many projections that were unanticipated. Earlier projections were basically concerned with the attainment of replacement level fertility (TFR=2.1). However, with respect to the unexpected fertility decline in the recent past from the North to the South, these assumptions have deviated to fertility levels lower than replacement level. Different fertility assumptions made by different projections are listed below, indicating that the over-the-year-end point of the TFR has declined over time.

Appendix Table 1: Fertility Assumptions by various projections in India.

Sl. No	Projections	Timeline	Future Fertility Scenario (Medium Scenario)
1	RGI, India, 1996	1991-2016	2.3 (2016)
2	RGI, India, 2006	2001-2026	1.8 (2026)
3	Leela Visaria, Pravin Visaria, 2003	1991-2101	1.8(2100)
4	Tim Dyson, 2004	2001-2051	1.8 (2051)
5	PFI and PRB, 2007	2001-2101	1.6 (2100)
6	WPP, 2012	1975-2100	1.84 (2100)
7	WPP, 2015	1975-2100	1.8 (2100)
8	Samir et al. (2017)	2001-2101	1.75 (urban) and 2.08 (rural)

In this study, we assumed four scenarios for fertility decline in India. The first scenario addresses the stabilisation of the TFR at replacement level fertility (TFR=2.1) by 2061, whereas the second scenarios assume that the TFR will converge to 1.8 children per woman by 2061, which is ideally followed by many recent projections by the United Nations for India (United Nation, 2015). However, based on the recent prevalence of fertility in the country, under different socioeconomic intersectionalities, the TFR for the majority of intersectionalities centred around and 1.6 to 1.4. Thus, given the possibility of the lowest-low fertility in India, we assumed the lowest possible attainable TFR to be 1.4 births per woman by 2061 as one of the emerging scenarios.

Appendix Figure 1: Trajectory of the fertility (TFR) under different assumptions.



Source: Authors' estimation based on SRS TFR estimates for 1986-2016.

Once the scenarios have been determined, the Brass Gompertz model has been exercised to extrapolate the fertility trajectory in India for the different scenarios of fertility.

Percent Age Distribution of Fertility

With the significant decline in the level of fertility in India, a definite shift in the distribution of births is also observed in the age pattern of fertility. Time-series data on the age-specific fertility rate have been exercised from the past four decades of data to analyse the pattern of the distribution of births across reproductive age groups (15-49). Over the annual distribution of births, the corresponding mean age at birth and standard deviation declined until 2006. However, an increase in the age at birth has been observed in recent years, substantiated by the declined standard deviation at birth (Office of RGI, 1981-2015). A large proportion of births were concentrated in the 20- to 29-year-old age group, with a rising proportion of births in the 30- to 34-year-old age group. However, the proportion of births to women younger than age 19 and older than age 35 has reduced significantly due to the rise in age at marriage and contraception use, especially among older women. DemProj automatically optimises the distribution of the births as per the imputed assumption of the TFR. Under given fertility scenarios (TFR), the distribution of births is mainly concentrated around the 24-34 age groups, whereas a significant decline in births is observed in the age group below 20 years and above 40 years.

Sex Ratio at Birth

Recent trends in the sex ratio at birth (SRB) have conspicuous fluctuations at national and subnational levels in India. When compared with past trends across the major states, the deviation in the SRB narrows as the SRB improves. Surprisingly, the South Indian states that had secular trends in SRB also worsened in the recent five-year period. Given the distortion in the SRB estimates in India and the discordance between survey and census estimates, it is immensely difficult to assume future scenarios for SRB. Many studies assumed that the SRB estimate would become secular over time. We also believe that with the rise in the level of urbanisation, in the affluence of states and in the improvement of the status of women, the SRB will improve and stabilise at the level of 105 girls per hundred boys at birth by 2061, which lies within the recommended global average (United Nation, 2015).

Life Expectancy at Birth

Life expectancy at birth (LEB) in India has observed a secular increase over the past years in India and states. A significant level of disparity in life expectancy at birth has been observed across India. The affluent states, such as Kerala, Karnataka, and Tamil Nadu, have a considerably higher life expectancy at birth than do less-developed states, such as Assam, Bihar, and Madhya Pradesh. However, with the progress in the socioeconomic profile of states in India, noteworthy improvements in the LEB can be documented in recent years. It has also been observed that the life expectancy of females has risen more sharply than that of males from 1981 to 2015, imparting wider gender differences in mortality. The past trends of LEB have shown an increase of nearly five years per decade for women, while for males, LEB has increased by approximately three years per decade. Thus, taking the same trends into consideration, the extrapolated results indicate that the LEB for males would be approximately 81 years by 2061, while for females, the value would be equal to 87 years.

Furthermore, the obtained values of LEB matched the LEB estimates of developed nations, and it was found that the LEB of India in 2061 matched the LEB of Japan in 2016.

Model Life Tables

The South Asian model life table has been adopted in the projection models.

International Migration

Migration is the third-most important component of population projection and is mostly assumed to be constant over time. In the previous projection, the Registrar General of India has assumed constant net migration, as obtained from the 1991-2001 census data in the absence of the 2011 census migration tables. In the projection based on 2011 data, the Registrar General of India assumed no significant role of international migration on the projection (Office of the Registrar General, 2011). However, in our projection model, we have assumed that the migration will remain the same throughout the period of projection.

1.2 RAPID Module

The RAPID module of Spectrum is an organised tool for estimating the workforce and economic outcomes aiming to meet the desired social and economic goals in a country. At the same time, it advances the requisites required to enable the achievement of the targets within the stipulated timeframe.

Economic inputs

The economic indicators for the inputs in the RAPID module include the labour force participation rate [LFPR] for males 10-14 years, LFPR for males 15-64 years, LFPR for females 10-14 years, LFPR for females 15-64 years, GDP at the base year (one-time entry) in INR, and percent annual growth rate in GDP. The LFPR for both males and females 10-14 years are obtained from different census rounds, in which census 1991 is taken as the base year, and the estimates of the LFPR obtained from the census rounds have been duplicated for the inter-census period. Among male children 10-14 years, we assumed LFPR to be 0.01% in 2061 because child labour may decline to nearly zero due to an accelerated effort to eradicate child labour in India. Among the males 15-64 years, the LFPR is assumed to be 86% in 2061 because its current trend shows decline (World Bank, 2019). Among the females 10-14 years, similar to their male counterparts, the LFPR is assumed to be 0.01% in 2061. The highest LFPR for females worldwide is observed in developing countries such as Tanzania and Zimbabwe, where it has reached approximately 79%, and for developed countries, the LFPR is approximately 65% (World Bank, 2019). Since we always use developed nations as a benchmark, we assume that India will reach an LFPR of 65% in 2061. The total GDP for the base year is taken from the statistics of the RBI. The annual growth rate of GDP during 1991-2016 has been estimated from the statistics of the RBI. As the country economically grows and becomes economically stable, the growth rate declines.

Hence, the annual growth rate in 2061 has been assumed to be 4%, with an initial growth rate of 8% until 2035, 7% until 2045, 6% until 2055 and 4% until 2061.

Education inputs

The educational indicators for the input of the RAPID module considers the age of entry into school (one-time entry), the number of years of schooling (one-time entry), the enrolment rates of schools (%), the number of students per school teacher, and the number of students per school separately for both primary and secondary schools. The age of entry to primary and secondary schools at the base year (1991) is considered to be 6 and 11 years, respectively. The number of years of schooling is five years each for both primary and secondary schools. The gross enrolment ratio (GER) is collected from the Unified District Information System for Education (U-DISE) fact sheets (U-DISE, 2017). In 2061, the GER is assumed to be 100% for both primary and secondary schools, since after more than four decades, almost all children in India are expected to enrol in schools up to the secondary level. The statistics on the number of students per primary and secondary school teacher are obtained from the U-DISE. The student-teacher ratio is assumed to be 13, as is observed among the developed countries.

Health inputs

The indicators of health for the inputs in the RAPID module are population per doctor, population per nurse, population per health centre, population per hospital, population per hospital bed and annual health expenditure. The statistics on the population per doctor, nurse, health centre, hospital, and hospital bed during 1991-2016 were taken from the World Development Indicators database (World Bank, 2019). For the year 2061, the statistics have been taken from developed counters, as India may achieve an equivalent health infrastructure in the next four decades and beyond. The annual health care expenditure per capita for the year 2014-15 was taken from the National Health Accounts Estimates for India (Government of India, 2017). The amount includes the expenditures from public and private sectors and donations from international agencies. For the estimates for the following years until 2061, the expenditure has been adjusted with the current rate of inflation.

1.3 FamPlan Module

This module is very useful in the sense that it captures various dimensions of growth in a country. These areas include the fertility and use of FP methods, the impact of FP, demographic events, fertility-related risk, mortality rates, post-abortion care, and associated costs and revenues. The inputs and assumptions of the FamPlan modules are described in the following points.

Contraceptive Method Mix and Source Mix

Contraceptive method mix refers to the percentage of contraceptive use by method to the total number of users. Thus, the sum of the contraceptive methods is 100%. The method mix has been calculated from contraceptive users as reported in NFHS reports (IIPS and ICF, 2017;

IIPS and Macro International, 2007; IIPS and ORC Macro, 2000; IIPS, 1995). For the base year, the estimates from the NFHS-1 have been used. During the inter-survey period, the values are interpolated using a linear interpolation method. For the year 2061, the percentage of limiting methods, particularly female sterilisation, has been reduced; similarly, the spacing methods have been increased because the government of India has introduced a new spacing method, such as injectables, into the method mix basket. Values between 2016 and 2061 were filled with the interpolated estimates obtained for all contraceptive methods separately.

The source mix is the percentage of contraceptive users who receive their services from different sources. The sum of the source mix is 100%. For this study, the sources were defined as public, private and NGOs. The information from 1991 to 2016 on the source mix was collected and estimated from the NFHS reports. For the information during the inter-survey years, the values have been interpolated. For the final year of the projection (2061), the share of public sources has been reduced, and the share of private sectors and NGOs has been increased. Thus, over the year, expenditures on FP may be reduced in the public sector, and the share may be increased in both the private sector and NGOs in the future. Thus, the source of contraceptive methods in the final year of the projection may be equivalent to that of developed countries.

Proximate Determinants of Fertility

The proximate determinants of fertility include a set of behavioural and biological variables that have a direct impact on the fertility outcome. These variables are the percentage of women who are married or in a union, postpartum insusceptibility, total abortion rate, and sterility. From the base year of the projection to 2016, the values for the percentage of women who are married or in a union and the duration of postpartum insusceptibility have been estimated from the NFHS survey rounds, and the values between the surveys have been interpolated. The percentage of women who are married or in a union in the year 2061 is assumed to be lower than the percentage in 2016 because of the increasing median age at marriage. Similarly, postpartum insusceptibility is assumed to be lower than the estimate in 2016 because of a decreasing trend in the duration of breastfeeding practices. The total abortion rate and sterility remain the same as those estimated for India throughout the projection period (Stover, Heaton, & Ross, 2006) because these values are less likely to change over time.

Child Survival

The inputs for child survival are needed for the base year, i.e., 1991. The indicators for child survival include the percentage of births with any risk involved, the IMR in the survey year, the under-five mortality in the survey year, the relation of risky births to contraceptive use, the relation of IMR to risky births and the relation of under-five mortality to risky births. The IMR and under-five mortality rates for the year have been collected from the Sample Registration System (SRS). The percentage of risky births has been estimated from the first round of the NFHS. All the coefficients for the relationships are assumed to be the default (Stover, Heaton, & Ross, 2006).

Cost of Services and Consultation Fees

The cost of services on the contraceptive methods was taken from MoFHW reports for the year 1991. The "Regression" option of the FamPlan module allows for the projection of future costs per user assuming a certain relationship. It assumes that the cost of services will decrease with an increasing number of future users or acceptors for a particular method (Stover, Heaton, & Ross, 2006). The consultation fees for the contraceptive methods are varied across the sources of supply. The fees from the public sector are free of cost. The fees for NGOs are assumed to be half of those of the private sector because NGOs are generally non-profit organisations while health institutions are for-profit. The consultation fees for male and female sterilisation may be equivalent to those for a C-section delivery, which is taken from a published paper for the year 2014 (Goli, Rammohan, & Pradhan, 2016). The fees for the other modern methods of contraception may be equivalent to the average of the charges for normal medical visits for treatment.

Method Attributes

Method attributes refer to the durability of each contraceptive method. For the limiting methods, the average age of female and male sterilisation is considered to be 26 years throughout the projection period. For long-acting reversible contraceptive methods, the average durations for Implanon (implant), copper T IUD and LNG-IUS are 2.5 years, 4.6 years and 3.3 years, respectively. The method attributes for the short-term contraceptive methods are defined as the number of units required for the one-year protection of a couple. The number of units for condoms, daily pills (one cycle), injectables (Depo-Provera for three months) and the LAM are 120, 4, 15 and 0.3, respectively.

Lactational Amenorrhea Method (LAM)

The LAM is a one-time input for the base year (one-time entry). The percentage of women who are using the LAM by months has been estimated from the first round of the NFHS.

The effectiveness of Contraceptive Methods, Impact Rates and Miscarriage Rate

The information on the effectiveness of contraceptive use has been taken from data on the default standard effectiveness (Stover, Heaton, & Ross, 2006). All the indicators of impact rates (one-time entry) have been either estimated from the first round of the NFHS or taken from the publications/report (Singh et al., 2018). The miscarriage rate varies between 10% and 20% across the global countries (reference). For India at the base year (one-time entry), this rate is considered to be 15% (0.15).

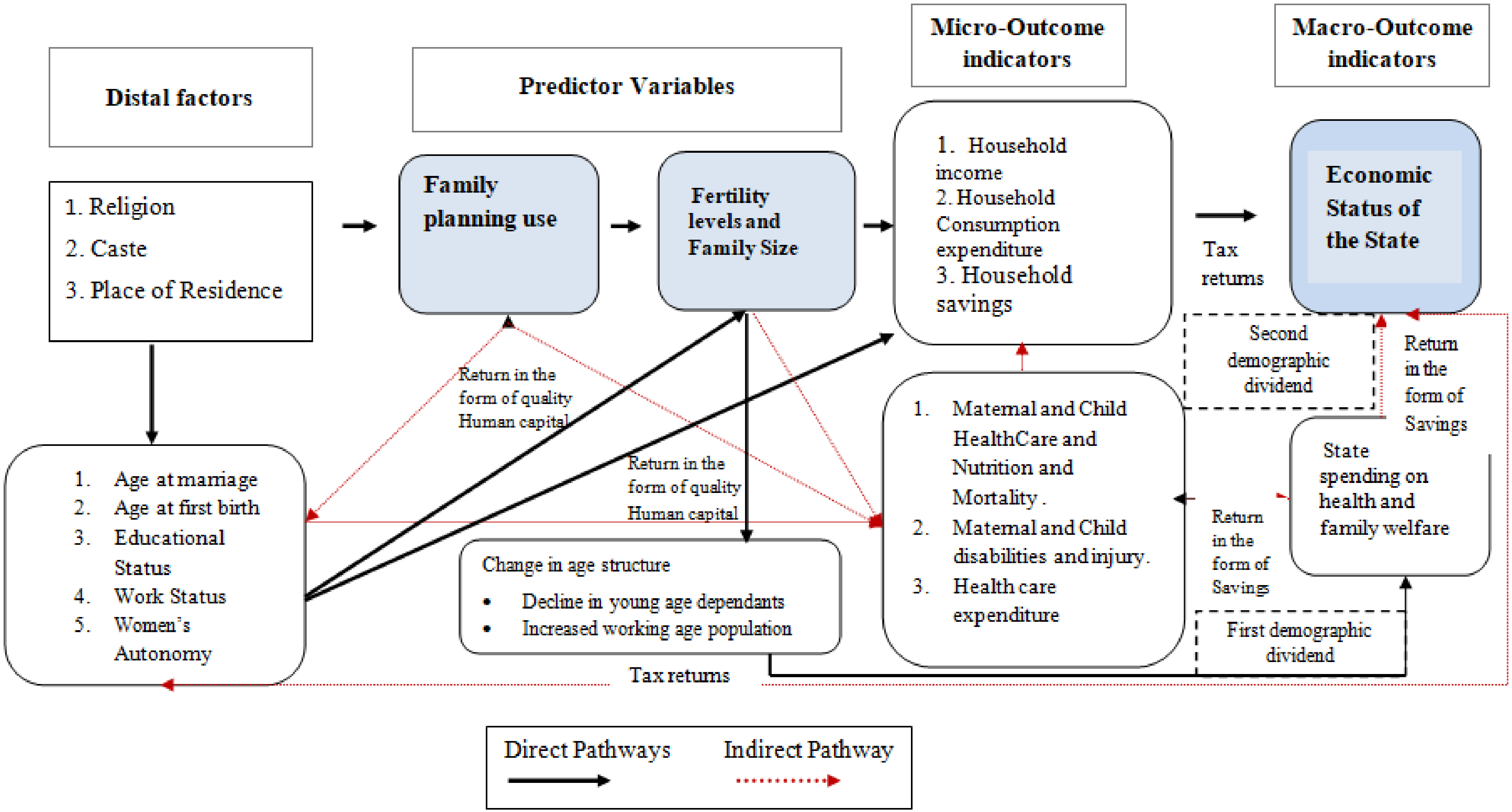
Post-Abortion Care

The percentage of legal abortions has been calculated from the sex ratio of each decennial census, assuming that the imbalanced sex ratio at birth is the result of illegal abortions. The percentage of legal and illegal abortions that require treatment is taken from published reports (Singh *et al.*, 2018; Cohen, 2009). The percentage of maternal deaths due to abortion is taken from a study of 5.9% of all maternal deaths in South Asia (Say *et al.*, 2014). The annual expenditure for post-abortion care at the base year of projection (single entry) is assumed to be the same as the cost of postnatal care (Goli, Rammohan, & Pradhan, 2016). The cost per abortion complication treated is assumed to be the same as the delivery cost (Goli, Rammohan, & Pradhan, 2016). The cost of annual FP counselling or service per case has been assumed to be the same as the fees for medical consultation (Goli, Rammohan, & Pradhan, 2016). The cost of abortion complications treated and FP counselling or service fees were adjusted with inflation for the following years and deflated for the previous years during the projection period.

Distribution of Fertility Related Risk

The distribution of fertility-related risk is represented by the percentage of women by age as well as birth order and by the percentage of children by birth spacing. These percentages have been estimated from the first round of the NFHS (1992-93).

Figure 1: Conceptual framework: Pathways through family planning and fertility decline influence economic outcomes



Note: The indicators in the shaded boxes show the predictor and outcome variables considered in the study.

Figure 2: Gross cost (in rupees) of family planning services in India, 1991-2061

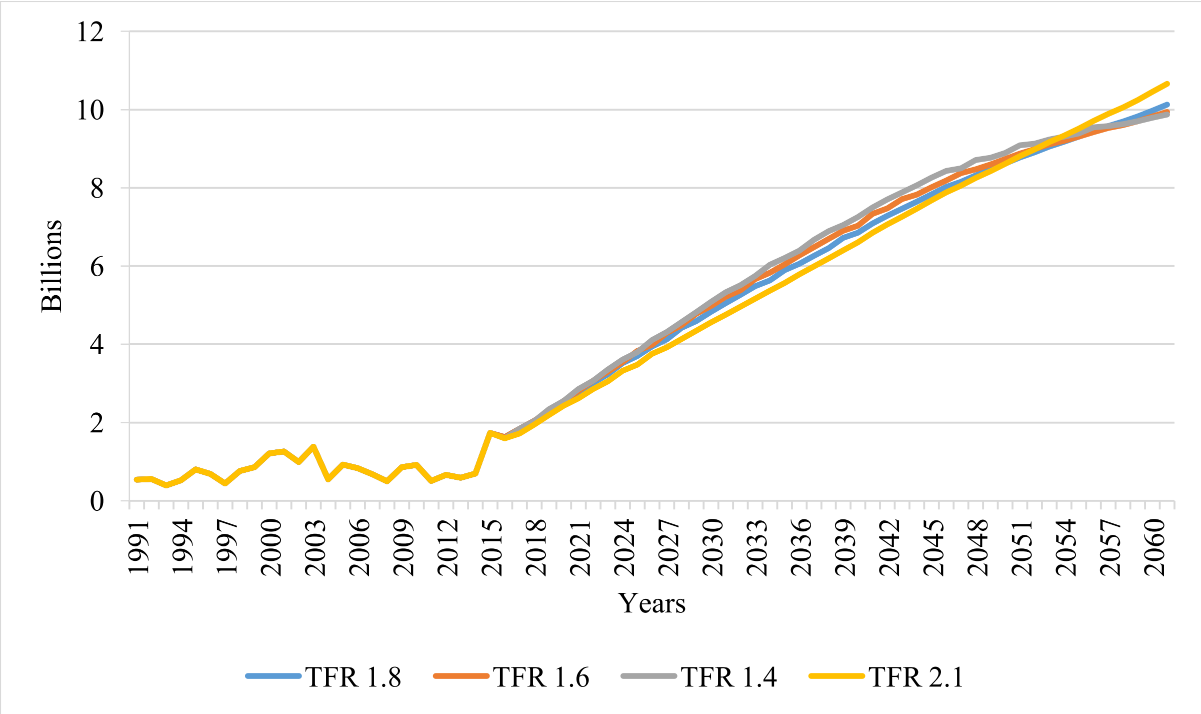


Figure 3: Revenue (benefits in rupees) generated from the population in India, 1991-2061

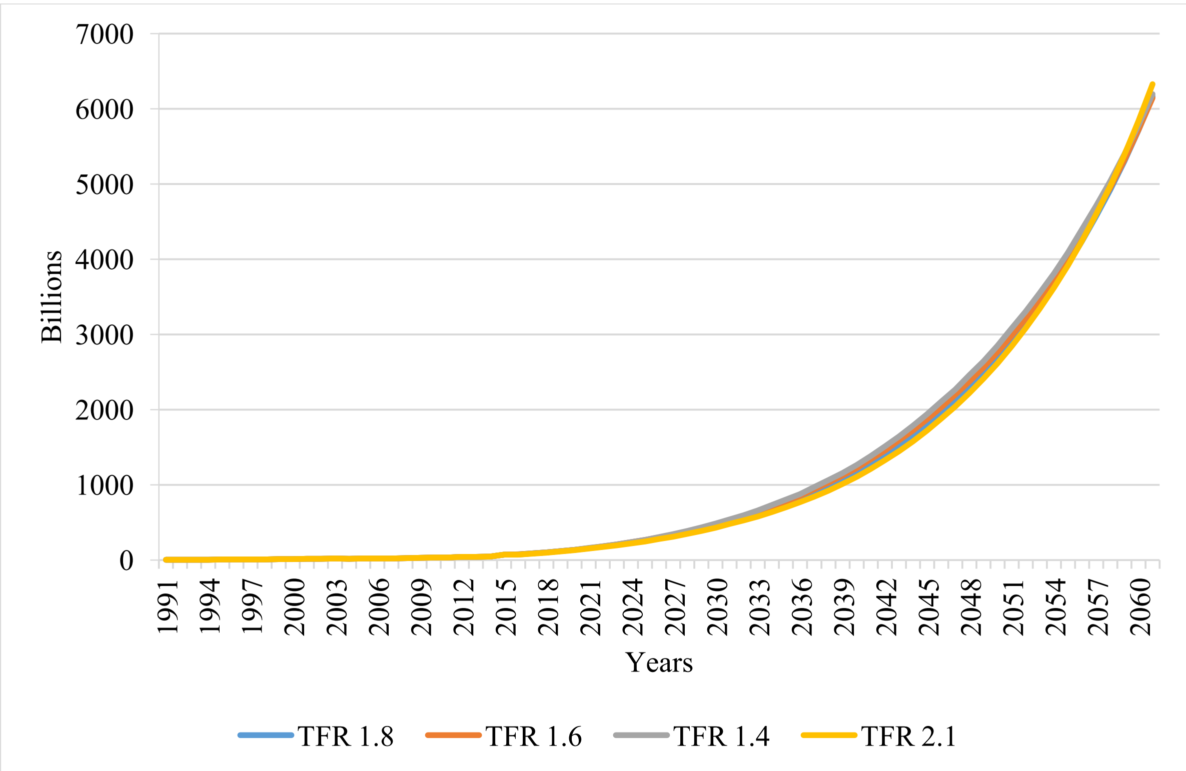


Figure 4: Cost-benefit ratio of spending on family planning in India, 1991-2061

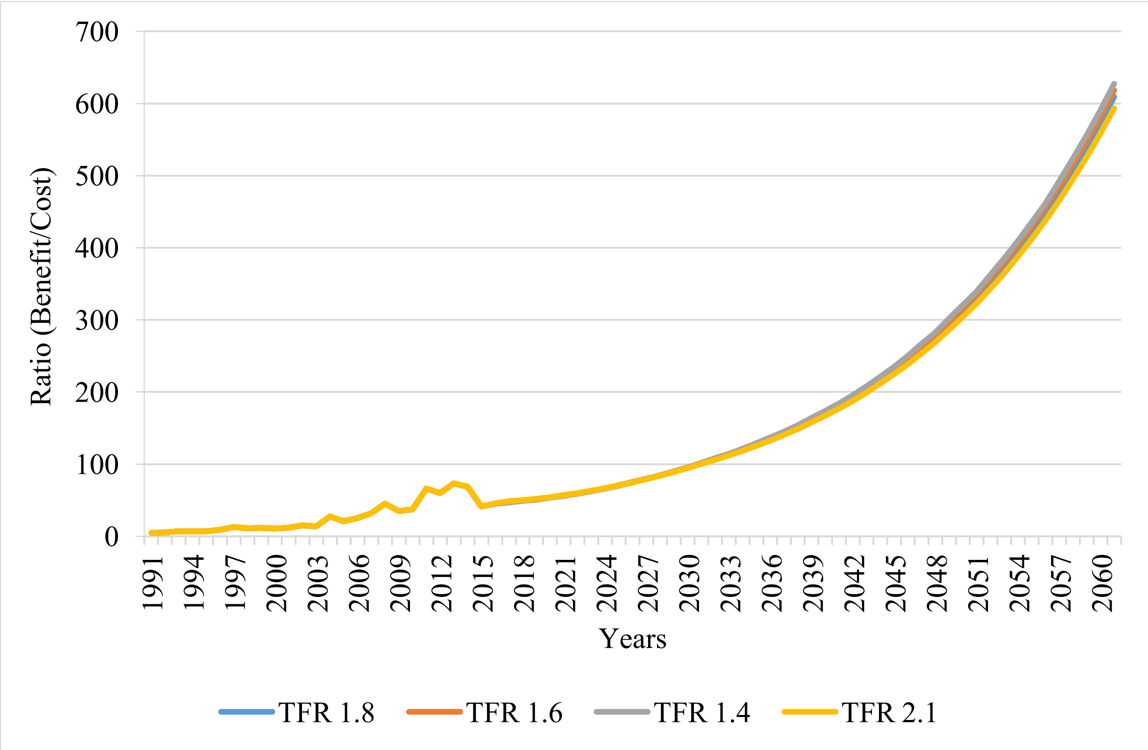


Figure 5: Gross Domestic Product (GDP) in India, 1991-2061

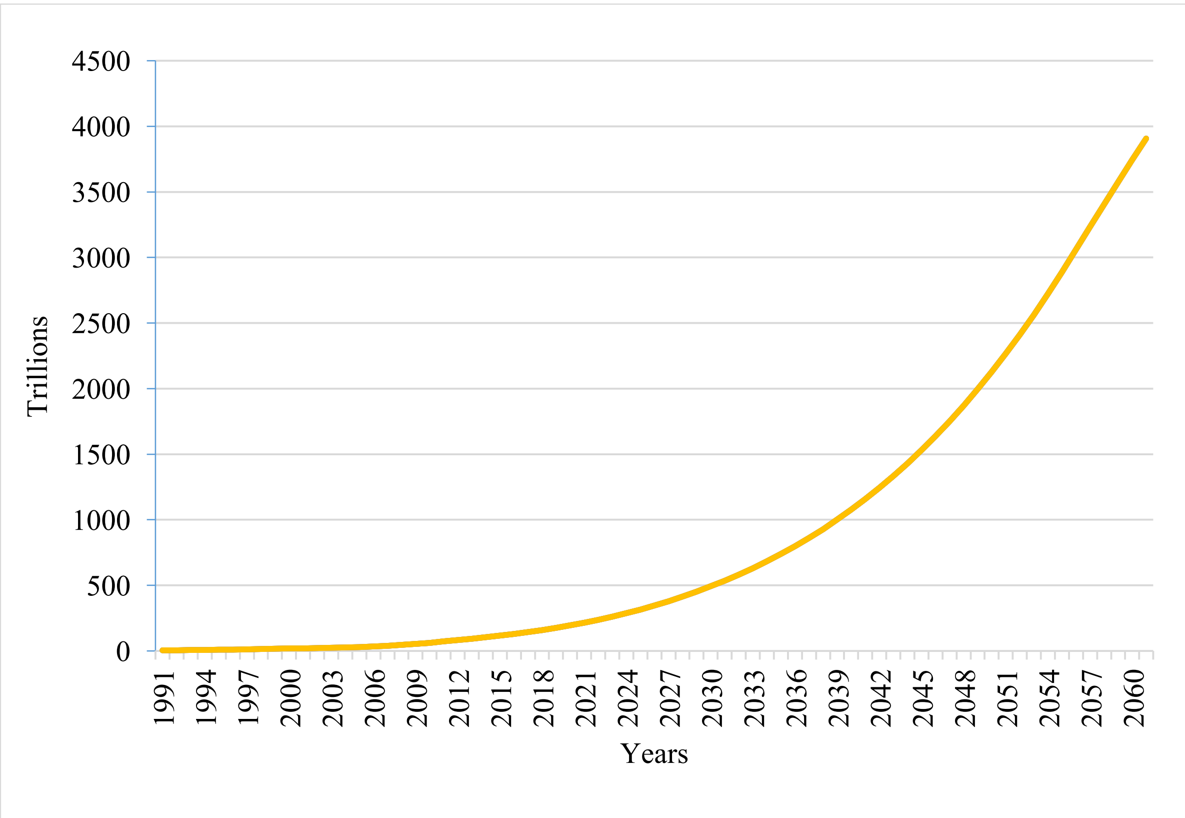


Figure 6: Gross Domestic Product (GDP) per capita in India, 1991-2061

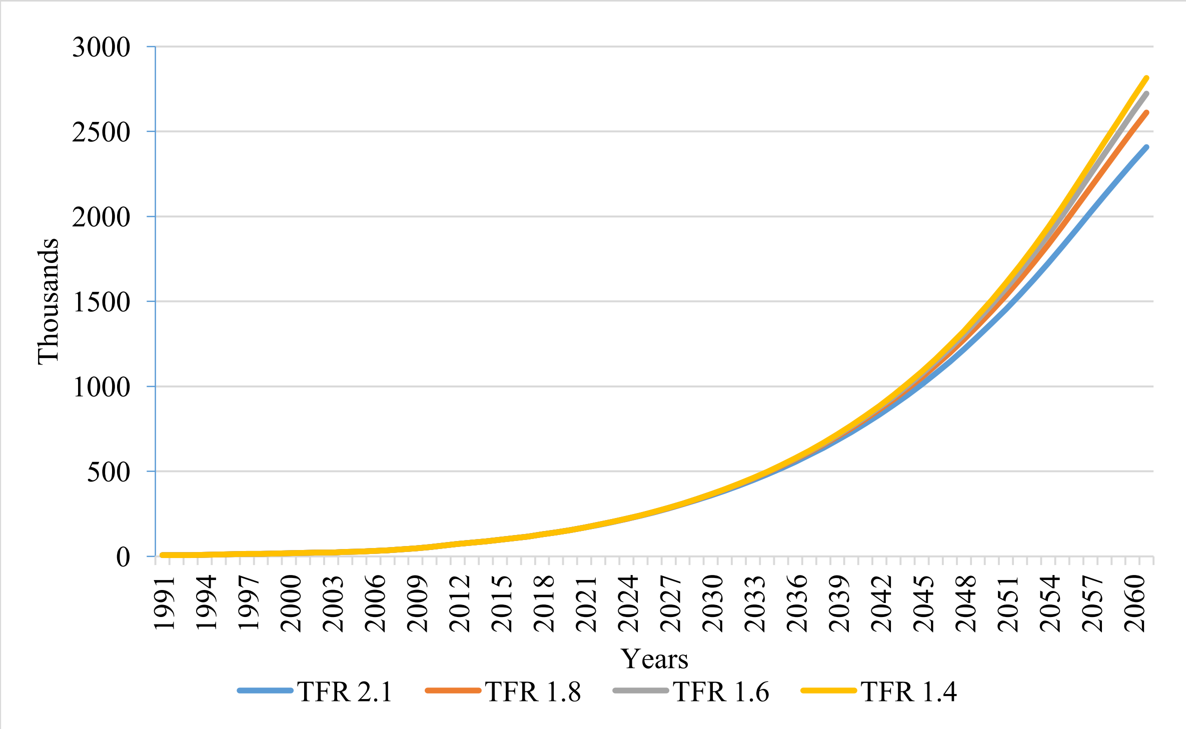


Figure 7: Potential number of primary school-age children in India, 1991-2061

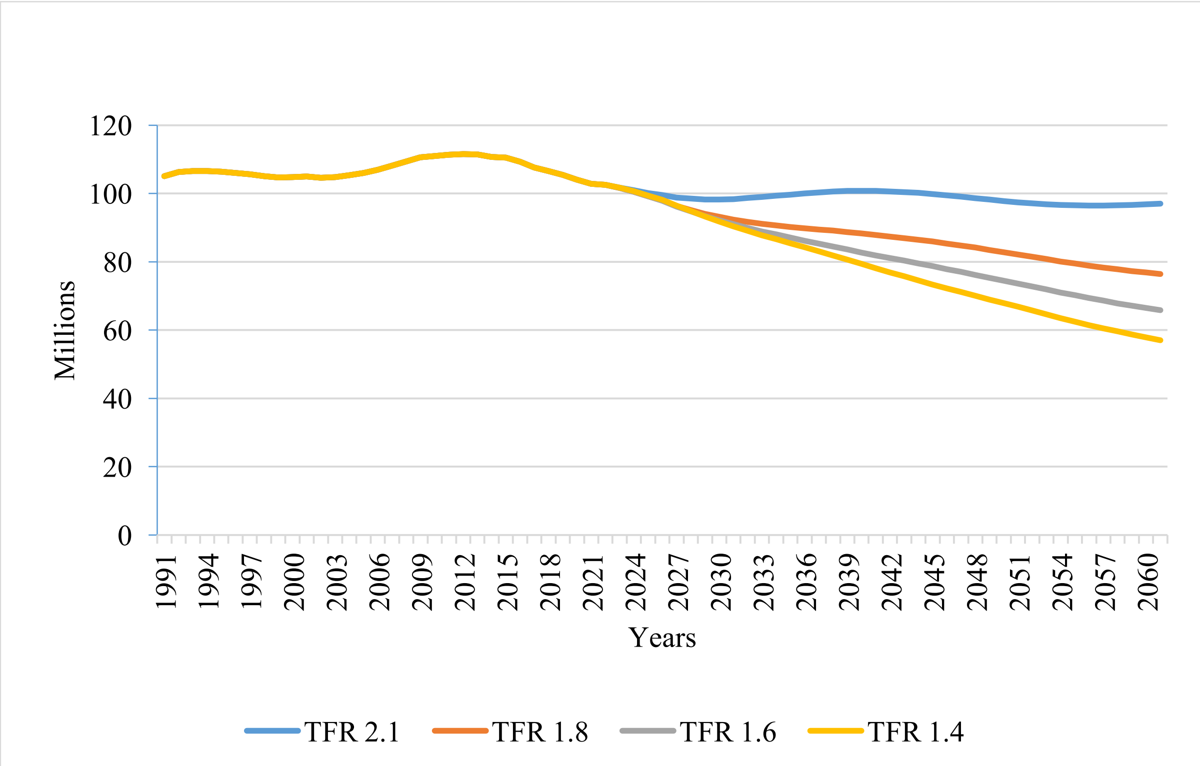


Figure 8: Potential number of primary students in India, 1991-2061

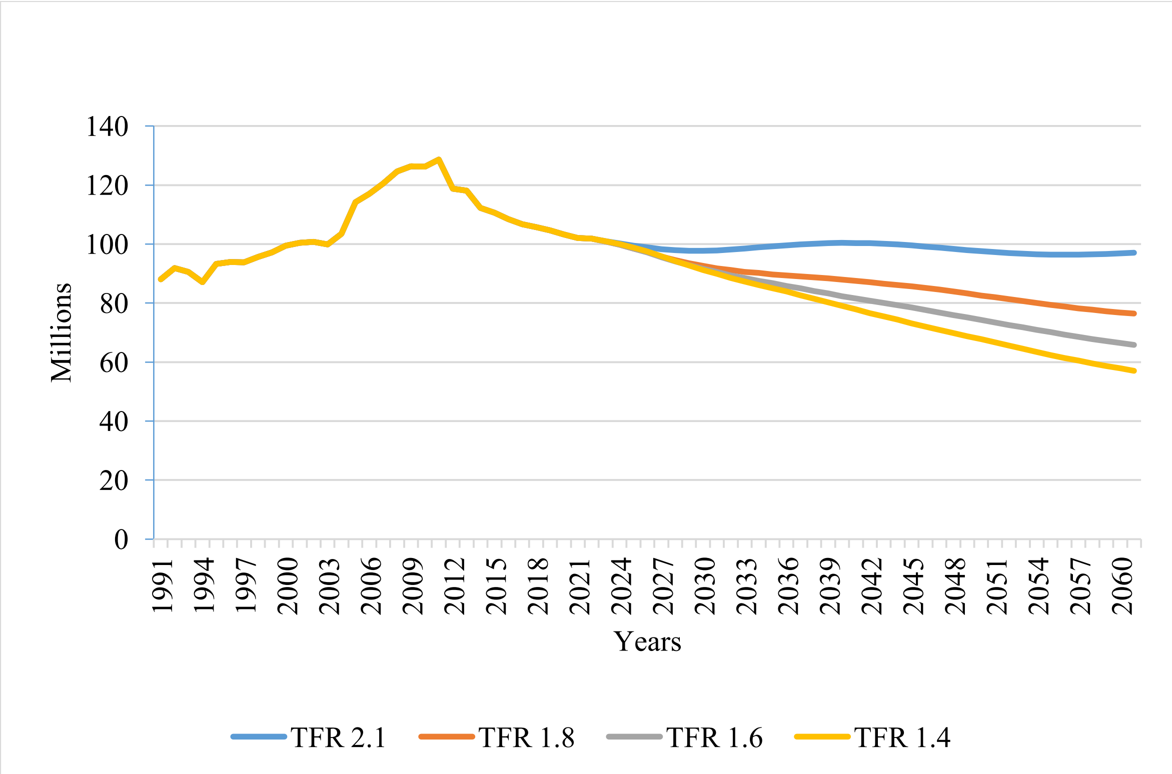


Figure 9: Potential number of secondary school-age children in India, 1991-2061

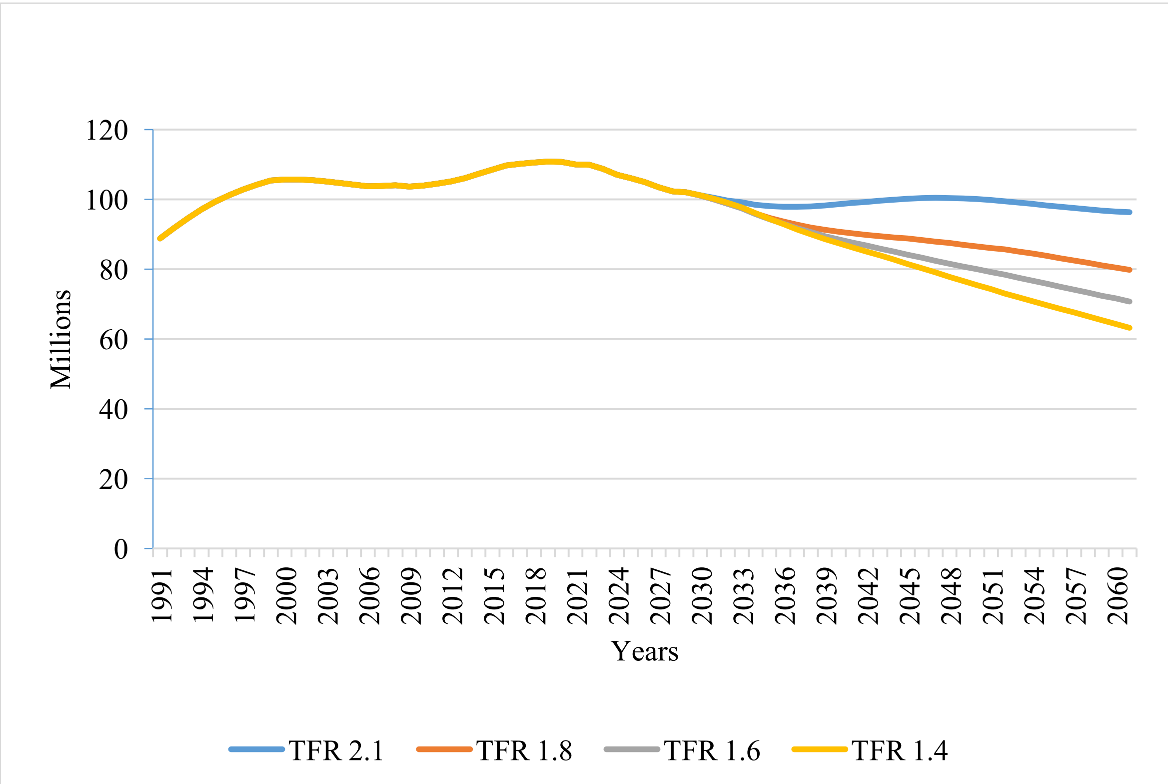


Figure 10: Potential number of secondary students in India, 1991-2061

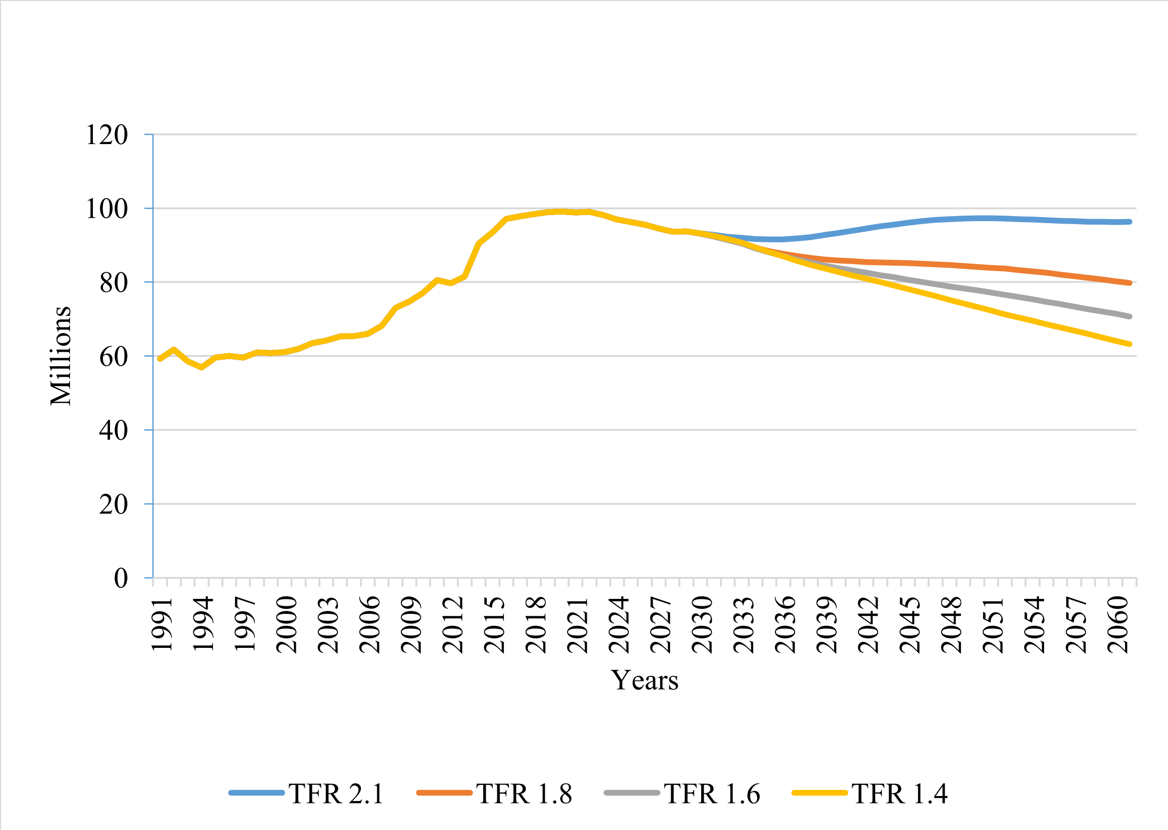


Figure 11: Potential number of primary school teachers required in India, 1991-2061

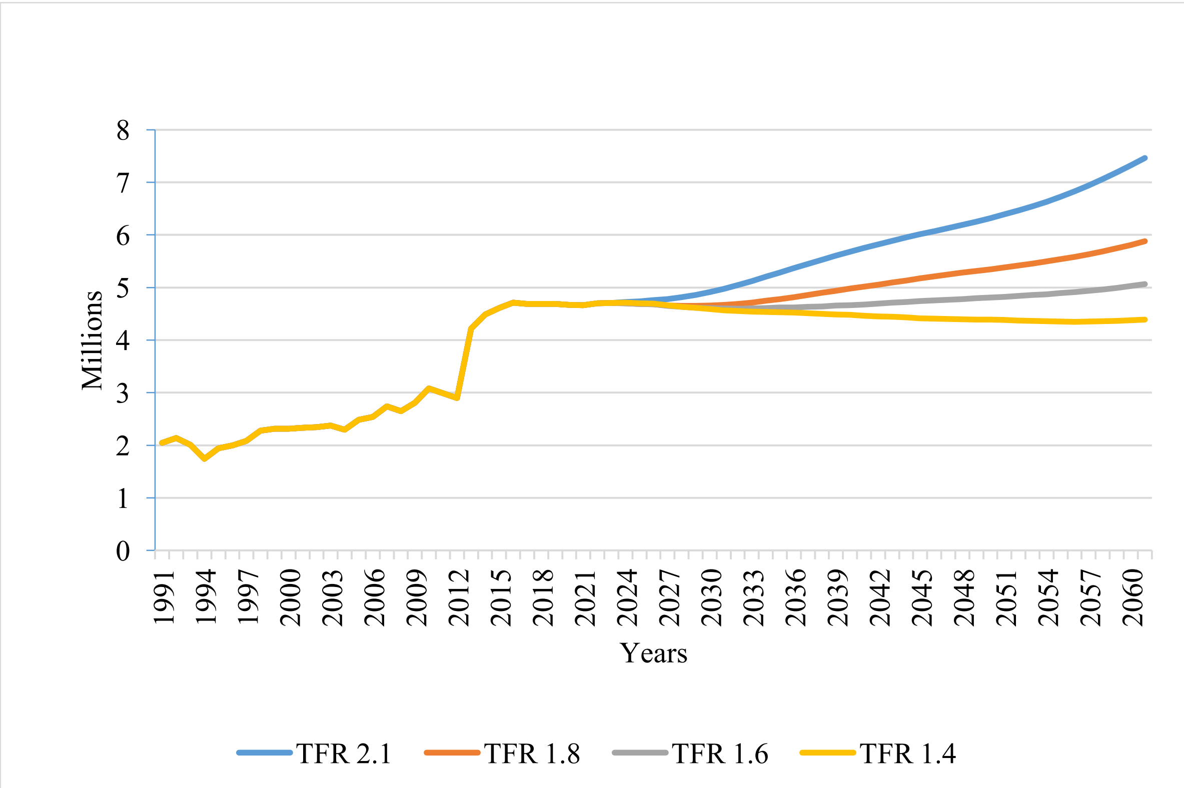


Figure 12: Potential number of secondary school teachers required in India, 1991-2061

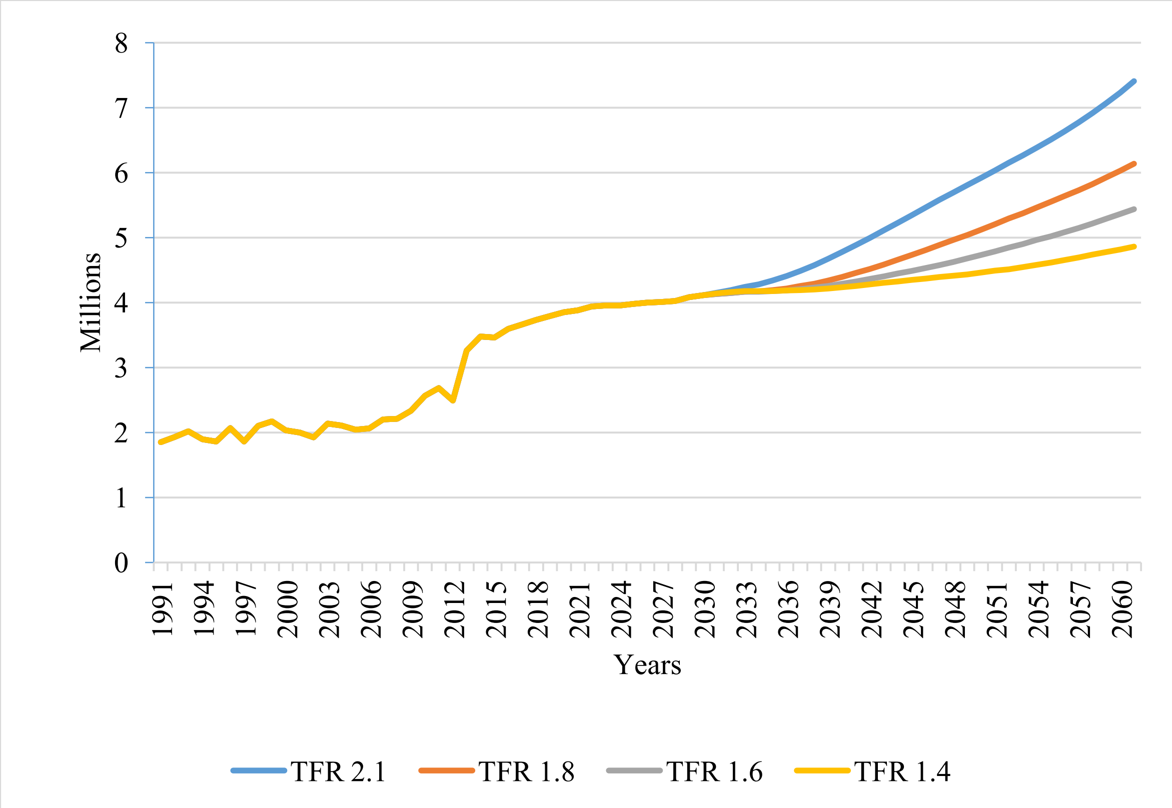


Figure 13: Potential number of primary schools required in India, 1991-2061

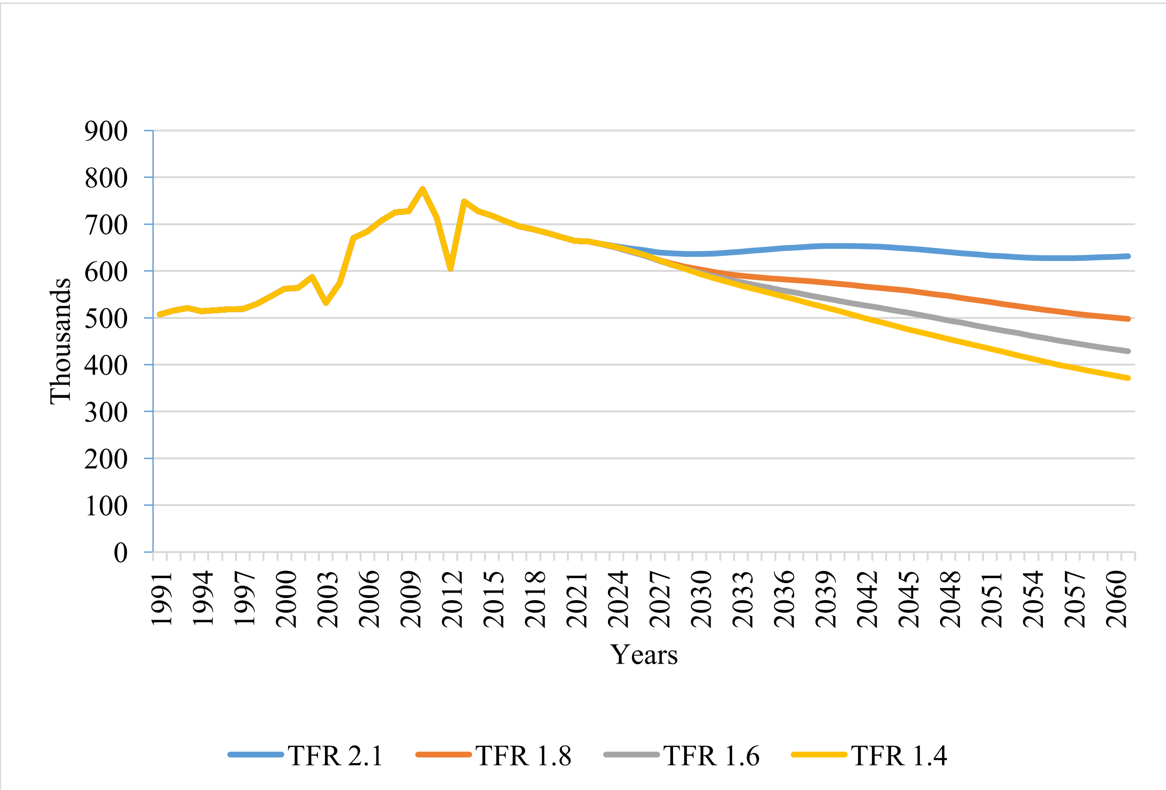


Figure 14: Potential number of secondary schools required in India, 1991-2061

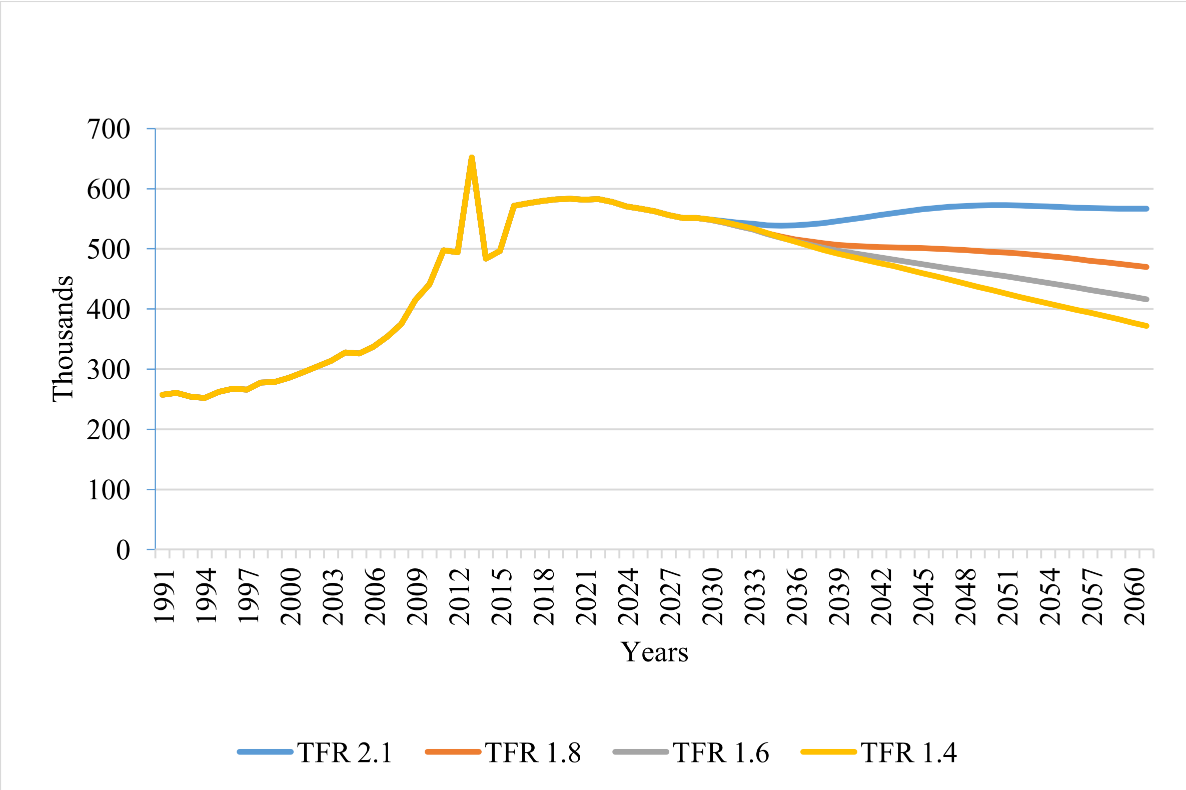


Figure 15: Potential number of doctors required in India, 1991-2061

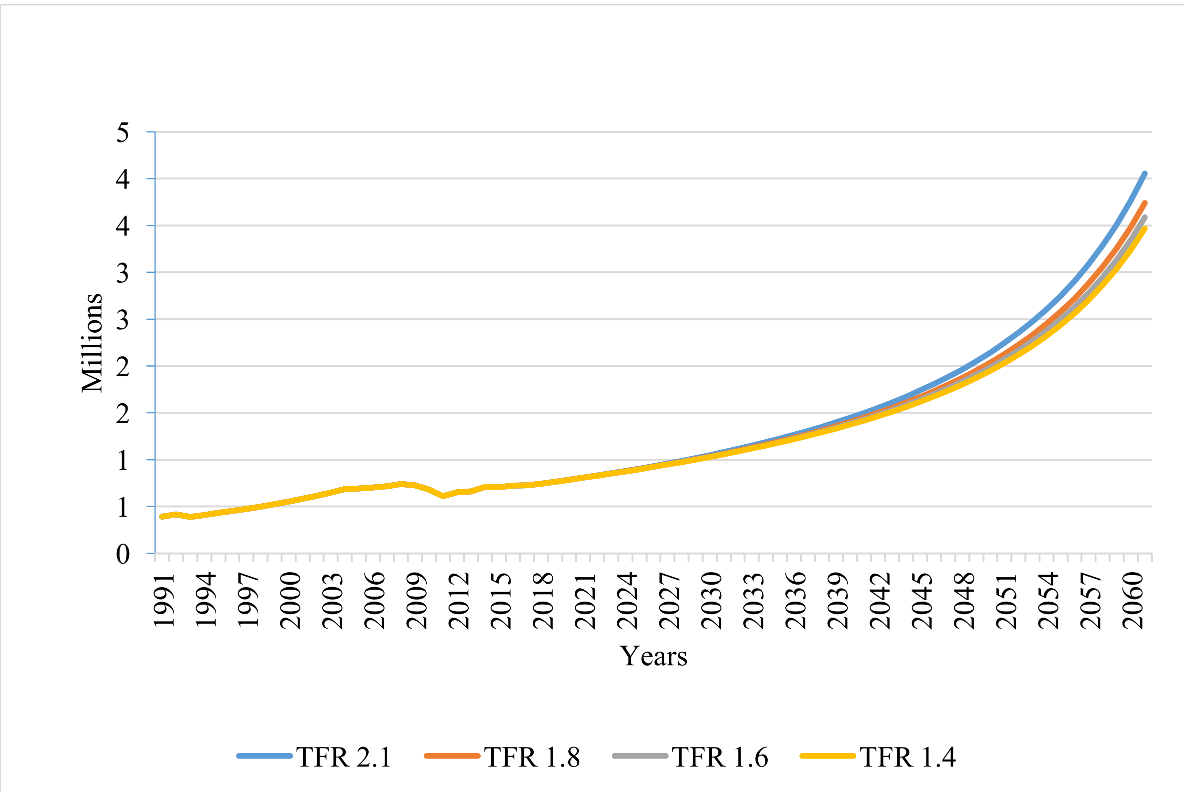


Figure 16: Potential number of nurses required in India, 1991-2061

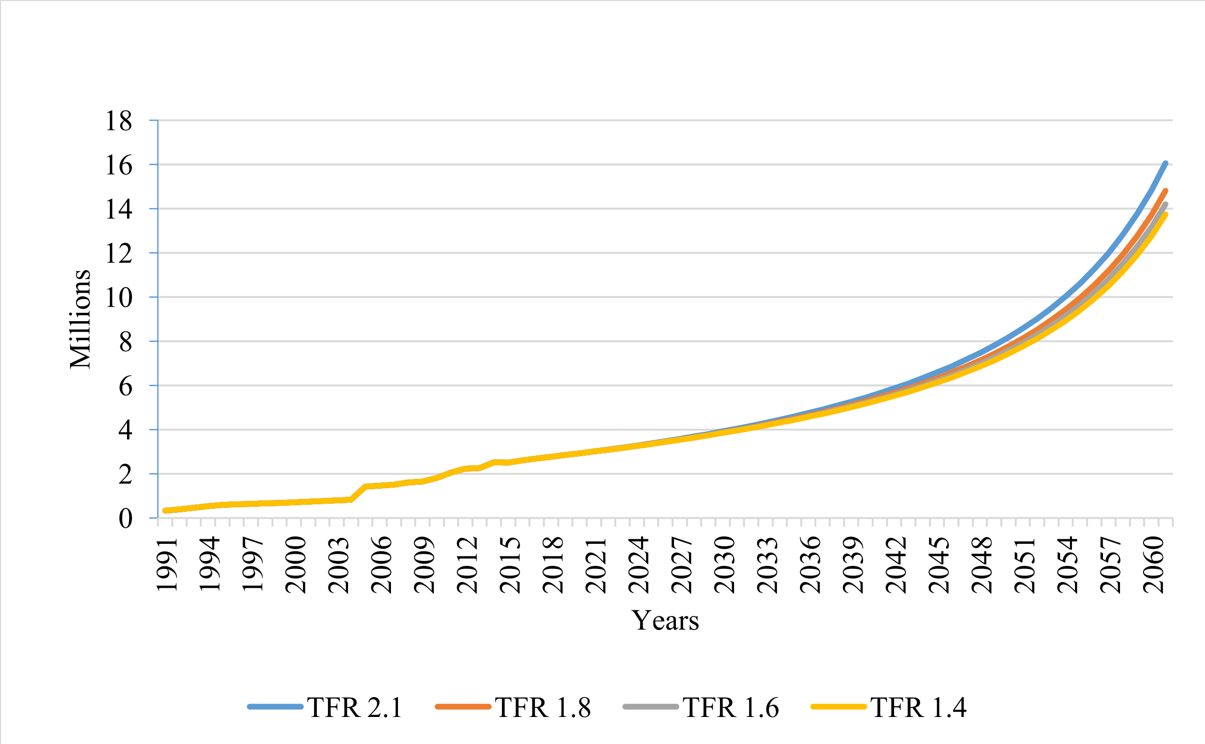


Figure 17: Potential number of hospitals required in India, 1991-2061

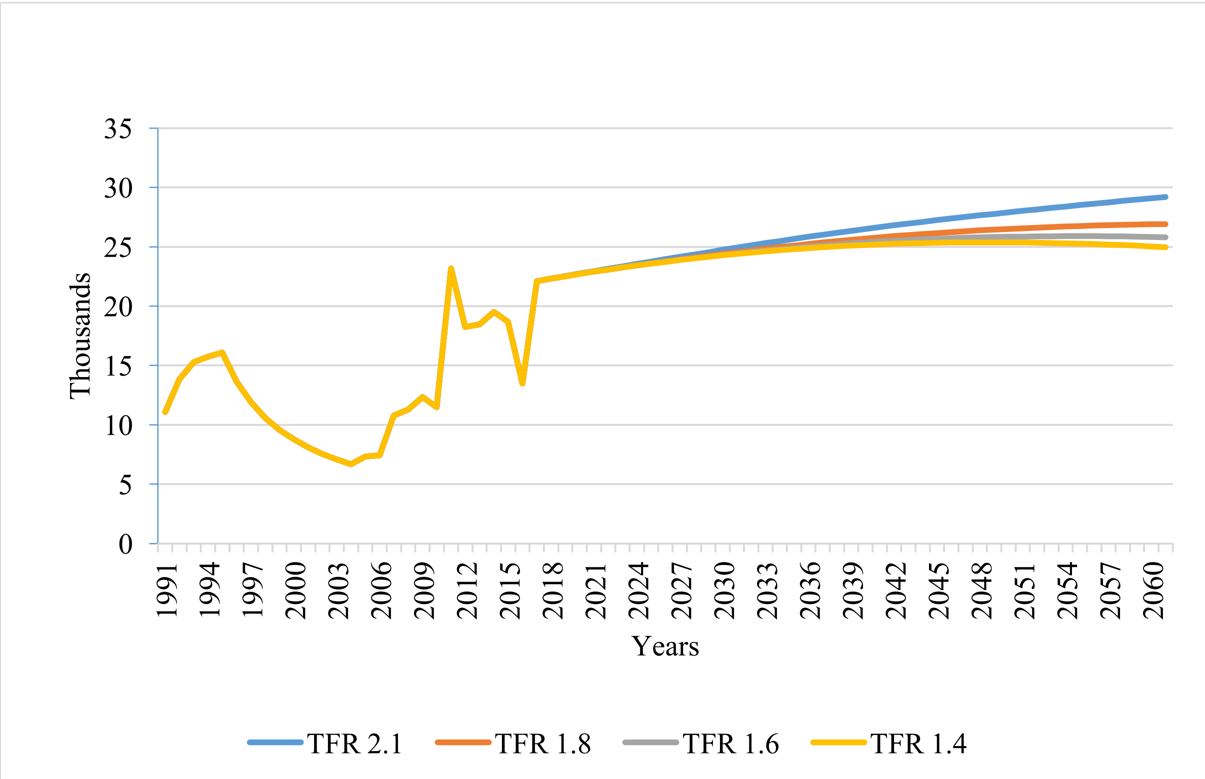


Figure 18: Potential number of hospital beds required in India, 1991-2061

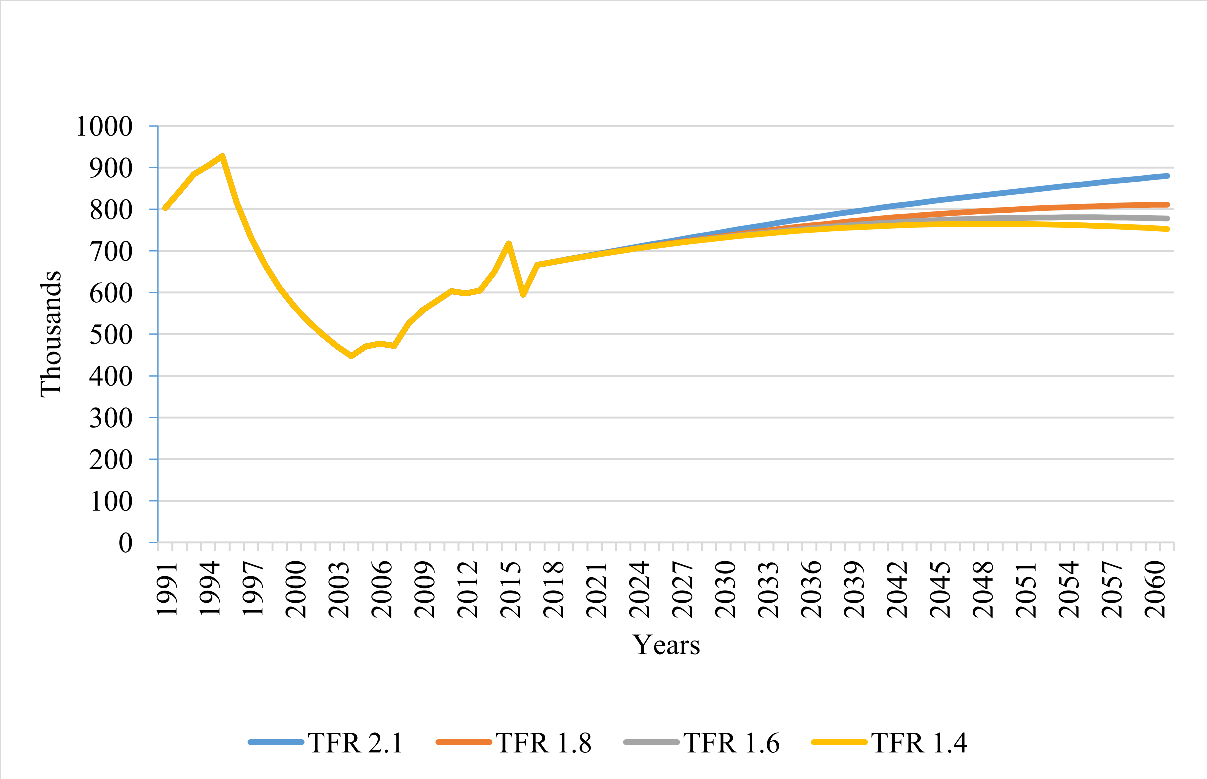


Figure 19: Annual recurrent health expenditure in India, 1991-2061

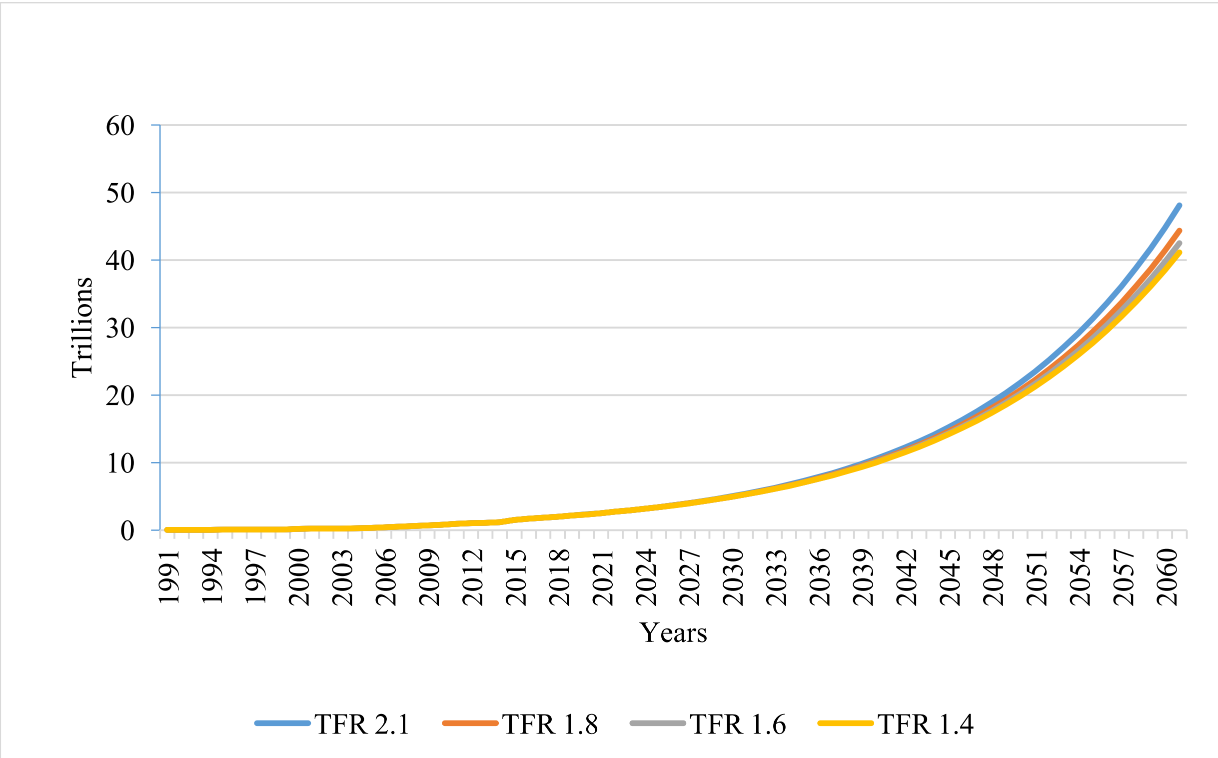


Table 1: Projected Cost-benefit ratios of fertility decline in India

Scenarios of fertility decline	2016	2030	2045	2061
TFR 1.6 (Medium)	45	96	230	609
TFR 1.4 (Low)	45	96	233	619
TFR 1.8 (High)	45	95	235	628
TFR 2.1 (Replacement)	45	95	224	594