Social Science Spectrum ISSN 2454-2806
Vol. 1, No. 3, September 2015, pp. 167-180

Rise and Fall of Between-State Inequalities in Demographic Progress in India: Application of "Inequality Life Cycle Hypothesis"

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Abstract

The objectives of this study are: first, to test the "inequality life cycle hypothesis" in the context of long-term demographic progress in India, and second, to identify the different stages of between-state inequality transition in the demographic progress and to predict its future pattern. We used direct estimates of demographic indicators from sample registration system for post-1971 and indirect estimates from various sources for pre-1971. We used a two-part methodology: First, we re-constructed the layout of "inequality life cycle hypothesis" to illustrate the evolutionary perspective of between-state inequalities in demographic progress. Secondly, we used standard deviations to obtain estimates of between-state inequalities in demographic indicators. The empirical verification of the long-term pattern of between-state inequalities in India revealed that the behaviour of inequalities is the same for all three demographic indicators selected: they were low in the pre-transition phase, then rose in the initial phase of progressive transition and started declining in later phases of progressive transition. Based on the projected findings, we can expect that by the time of post-demographic transition phase, between-state inequalities will return to their steady state equilibrium. This study provides a generalized framework for understanding the behaviour of between-state inequalities in the demographic variables in India.

Key words: Between-State Inequalities, Demographic Progress, India

I. Introduction

In the 60 plus years of post-independence India, average fertility and mortality levels have considerably declined and life expectancy has improved (Rele, 1987; Dyson et al., 2004; Visaria 2004b; Ram & Ram, 2009; James & Nair, 2005; Kulkarni & Alagarajan 2005; Alagarajan & Kulkarni 2008; Kulkarni, 2011; RGI, 2007, 2012). Infant Mortality Rate (IMR) in India in 1951 was 150 per 1000 live births, which declined to 40 per 1000 live births in 2013 (RGI, 2014). Similarly, Life Expectancy at Birth (LEB) in India in 1951 was 31 years, which increased to 68 years during 2009-13. The average life of an Indian was increased by 13 years in a period of 30 years (Rele, 1982, 1987; Guilmoto & Rajan, 2001; RGI, 2007). Consequently, the Total Fertility Rate (TFR) fell from an average of 5.8 children per woman in 1951 to 2.3 children per woman in 2013 (Rele, 1987, RGI, 2013). Insertion of India's demographic trends in the classical demographic transition model reveals that they are transiting from the third to fourth phase of demographic transition (Visaria, 2004b; Arokiasamy & Goli, 2012; Goli & Arokiasamy, 2013a; Goli & Arokiasamy, 2013b). The country is also in the middle of the second phase of epidemiological transition (Visaria, 2004a; Koli et al., 2014).

However, the demographic progress is not uniform across the states and the socio-economic groups (Guilmoto, 1992; Guilmoto & Rajan 2001, 2011; Visaria 2004b; James & Nair 2005; Kulkarni & Alagarajan 2005; Alagarajan & Kulkarni 2008; Saikia et al., 2011; Arokiasamy & Goli, 2012; Goli & Arokiasamy, 2013a). South Indian states, urban areas and higher socio-

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economic groups are approaching low fertility, with some categories such as the upper wealth and education quintiles of low fertility states reaching the lowest-low fertility rate (TFR of 1.3). North Indian states, rural areas and disadvantageous socio-economic groups still have higher fertility rates until recently, now show the sign of progress in the last few years (Kulkarni & Alagarajan 2005; Alagarajan & Kulkarni 2008; Guilmoto & Rajan 2001, 2011; Arokiasamy & Goli, 2012; RGI, 2014). Recent studies that have assessed the progress in life expectancy across the states in India have also indicated a considerable inter-state disparity (Saikia et al., 2011; Goli & Arokiasamy, 2013). While the transition has been fast by international standards in Kerala, Tamil Nadu, and Himachal Pradesh, it has been very slow in states like Bihar, Madhya Pradesh and Uttar Pradesh (Goli & Arokiasamy, 2013b). The situation of IMR is more or less similar in spite of the tremendous progress achieved over the period. A comparison of IMR among the major states reveals that it varies from 12 per 1000 live births in Kerala to 54 per 1000 live births in Madhya Pradesh and Assam. Four states of India have IMR 50 and above per 1000 live births, whereas Kerala (12 per 1000 live births), Tamil Nadu (21 per 1000 live births), Punjab (26 per 1000 live births), Delhi (24 per 1000 live births) and Maharashtra (24 per 1000 live births) are the only states having IMR of less than 30 per 1000 live births (RGI, 2014; Goli & Arokiasamy, 2013a).

This rise and fall of the between-state and between-group inequalities in the demographic indicators have invited attention of demographers, public health and social science researchers in India (e.g., Subramanian, 2008; Joe et al., 2009; Pradhan & Arokiasamy, 2010; Saikia et al., 2011; Pathak & Singh, 2011; Kumar & Mohanty, 2011; Subramanyam & Subramanyam, 2011; Arokiasamy et al., 2012; Goli et al., 2013; Goli & Arokiasamy, 2013; Ram et al., 2013). These studies on demographic and health inequalities in India have not moved beyond quantifying the recent trends in demographic and health inequality and its socio-economic determinants. The findings of this sheer volume of inequality studies endure inadequate conceptualization of change in the between-state inequalities as a process of diffusion and intervention. Thus, they do not provide a generalized and unifying theory of the long-run evolution of inter-state inequality in the demographic variables. Further, these studies have failed to incorporate the historical perspective but continued to debate largely through the most recent available information. Analyses based on the recent data have serious limitations in terms of understanding the true trajectories of between-state inequalities. Recent trends in inequalities towards convergence have captured a relatively small portion of the “inequality life cycle” and masking a much more complex history of between-state demographic and health inequalities. Moreover, with recent data it is difficult to predict the critical turning points in the past, present and future trends in demographic and health inequalities.

Further, with the existing demographic or public health theories, we cannot predict with confidence whether demographic and health inequalities will diminish or grow with demographic progress. There are some assumptions about current and near future demographic scenario of Indian states which looks to be a period of continued convergence (Arokiasamy & Goli, 2012; Goli & Arokiasamy, 2013a). Therefore, there is need for a logical and theoretical framework to assess, monitor and review the long term inequalities alongside the progress in averages of demographic and health status. Also, there is a need to look far beyond the customary demographic theories and anticipate the consequences of imbalance between different states and socio-economic groups. The objectives of this study are: first, to test the “inequality life cycle hypothesis” in the context of long–term demographic progress in India, and second, to identify the different stages of the between-state inequality transition in the demographic progress and predict its future pattern.

II. Data

In this study, we have used two types of demographic estimates: first, we obtained direct demographic estimates from Sample Registration System (SRS) for the period 1971-2014 (RGI, 2007, 2014). Data on IMR, TFR and LEB were used as summary measures of the demographic status across the major states of India. Since the early 1970s, India’s SRS has been the authoritative source of mortality and fertility estimates. The SRS is, in essence, a demographic sample survey based on a dual-record system, designed to provide reliable estimates of mortality and fertility indicators for India and its states. It involves both continuous registration of births and deaths, and half-yearly surveys to record missed events. The SRS is based on a nationally representative sample of villages and urban blocks. The revision of the SRS sampling frame is undertaken every 10 years based on the results of the latest census. For all the years, sample design and sample size were such that the outcomes are comparable over time (for details on sampling, see RGI 2007, 2014).

Second, the historical TFR and LEB data in the pre-1971 period for India was constructed based on indirect estimates of various sources: (1) Data on TFR during 1951–1961 was based on Rele estimates (Rele, 1987). The Rele estimates of TFR are considered to be robust compared with other available estimates prior to the SRS estimates. Rele estimated TFR on the basis of the age-sex distribution of the populations. First, he derived child-woman ratios (CWR) of age-sex distribution of the populations, the estimated the gross reproductive rate (GRR) from the linear regression coefficient from the CWR at fixed values of LEB and then derived GRR was multiplied by 2.05 to get the TFR. (2) The LEB data for the pre-1971 period was obtained from estimates provided by Rele (1987) and Guilmoto & Rajan (2001). These estimates of LEB were computed from the trends based on Bhat (1987) and RGI (2007, 2014). Estimates of total LEB are averages of male-female LEB. Pre-1971 IMR estimates are available from Chandrasekhar (1959, 1972) and Mitra (2005), but the quality of data is poor and inconsistent. Therefore, in the case of IMR, we rather depended on a downward projection of the trend to predict the pre-1971 scenario of between-state inequalities; while forward projection method is adopted to predict future scenarios.

III. Methods

In this study, we adopted the two-part methodology. In the first part, we re-constructed the layout of the "inequality life cycle hypothesis" to illustrate the evolutionary perspective of inter-state inequalities in the context of demographic progress. There is a need to re-emphasize the importance of this hypothesis, particularly in the context of demographic indicators because, unlike income levels, all the demographic indicators have lower and upper bounds of growth. Thus, theoretical discussion and measurement of different regimes of the "inequality life cycle hypothesis" and correlating it with demographic transition regimes make the argument on demographic progress more meaningful.

In the second part, we estimated the standard deviation (SD) for all the three demographic indicators, *viz.,* IMR, TFR and LEB across the major states in India as a measure of between-state inequalities. Given the scale on which the demographic and health variable is distributed, the standard deviation is the preferable and reliable measure of variance for assessing the "inequality life cycle hypothesis" (Dorius, 2010). Conventional measures of inequality such as the Gini coefficient or Theil measures of entropy are mean standardized measures. Through these measures, the level of inequality is calculated as a ratio of the variation of the mean. "The application of mean standardized measures of inequality to continuous variable is preferable for assessing convergence, but when a variable is either absolute or logically bounded, mean-standardized measures infringe two key principles: the anonymity and the welfare principles. This infringement occurs because when variables are logically or absolutely bounded, often the variable can be shown in the metric form (Y) or the complementary form (~Y). In many instances, the variance in Y may be declining, while the variance in ~Y may be simultaneously rising (or vice-versa). When a measure of inequality produces contradictory estimates of inequality for Y and ~Y, the measure is said to violate the anonymity principle" (Dorius, 2010). The application of formal measures of inequality to assess the "life-cycle of inequality" in bounded variables puts greater value on some units than others; in that case, it violates the welfare principle. Thus, Dorius (2010) argued that for measuring progress in inter-country inequality, the standard deviation is the preferable measure, especially when the variable is bounded to the upper and lower bounds. The standard deviations of Y and ~Y are identical, meaning that the standard deviation will make the same estimate of inequality regardless of whether a variable is measured in the metric form or the complementary form. By extension, this means that the standard deviation does not violate the anonymity rule.

When each unit gives equal weight with the standard deviation regardless of whether the units are near or far from the bounds of the variable scale, applying the standard deviation avoids problems related with the welfare principle.

Further, based on the inequality trends of IMR, LEB and TFR derived from the actual data available, we fitted a two & three-order polynomial regression lines, which gave the highest R^2 value and close to the data (*i.e.* minimizes the error) among all the available trend line fits. However, there are two purposes of fitting a regression based trend options: (a) to show how the overall pattern of the inequality trend looks like? For example, is the line going up or down or is it forming a cycle? If it is forming a cycle, then it helps to identify the different stages of the "inequality life-cycle", and (b) to make (loose) predictions about how did between state inequalities progress in the future. If the line is going down, at what rate is it moving and when will it be likely touch a point near to zero (although this scenario is a rare possibility in reality)? Also, in the absence of reliable historical data on key demographic indicators, to predict historic pattern of inequality with forward and backward projections could be a useful exercise.

IV. ''Inequality life cycle hypothesis" in demographic progress

This hypothesis[1] is defined as a consistent pattern of change in inequality that follows an inverted U-shaped curve. It moves from equilibrium to disequilibrium and returns to equilibrium (Firebaugh, 2003; Dorius, 2010). Firebaugh and Dorius extended the "inequality life cycle hypothesis" based on the Kuznets (1956) framework of the income distribution to other social indicators like gender and educational inequality (Firebaugh, 2003; Dorius, 2010, 2013). According to it as an economy develops, a natural cycle of economic inequality occurs (driven by market forces in the industrial economy) which at first increases inequality and then decrease it after a certain average income is attained (Kuznets, 1956). In fact, recent empirical work suggests that a pattern similar to the one observed by Kuznets (1956) has also occurred for life expectancy and possibly in the fertility progress (Lesthaeghe, 1983; Madison 1995; Wilson, 1999; Firebaugh, 1999, 2003; Easterlin 2000; Bourguignon & Morrisson 2002; Vallin & Mesle, 2004; Dorius, 2008, 2010; Goli & Arokiasamy, 2012).

Similar to economic theories, the "human ecological-evolutionary theory" with its historical and homeostatic perspective offers a promising framework for understanding the stages of demographic transition and convergence process (Wilson 1999; Wilson & Airey 1999; Crenshaw et al., 2000; Lenski, 2005). In its original form, the demographic transition theory has a strong homeostatic perspective, directly and indirectly arguing for a demographic steady state, or, what Easterlin (2000:23) referred to as an "imminent stationary state." The pathways of the demographic convergence process lie in the demographic transition or demographic regimes[2]. All the transitions pass through three stages: (1) pre-transition: homogeneity regime[3]; (2) progressive

[1] By using the word cycle, Dorius (2010) is not suggesting that inequality is cyclical in the same way as in some human development life cycle models. Rather, he uses the term to highlight the curvilinear rise and fall of inequality. Inequality trends are only cyclical in the sense that inter-country inequality is low before rising high and that it eventually returns to the steady state.

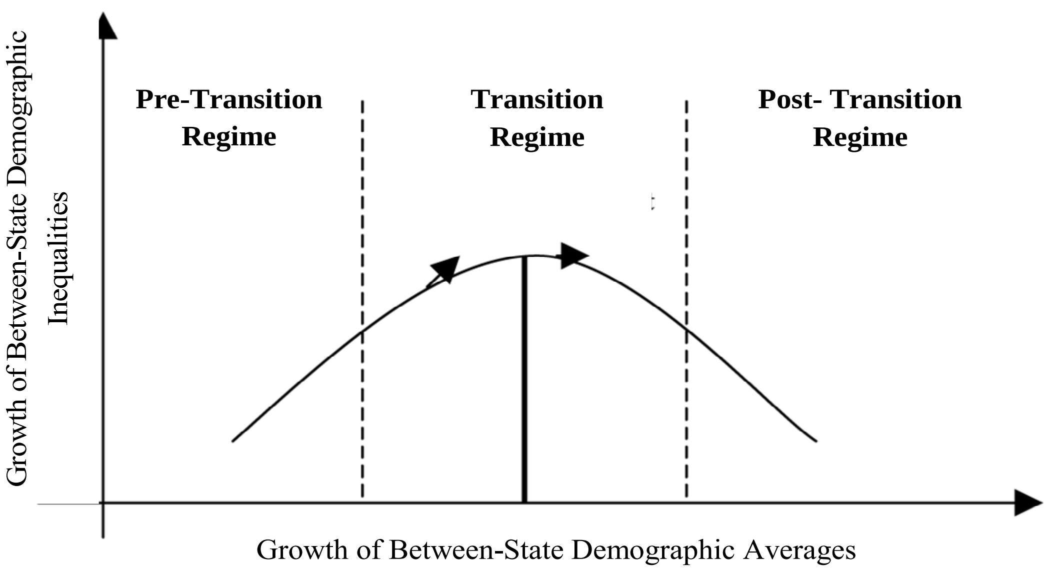
[2] The concept of demographic regimes was introduced by Landry (1934), but has never gained the prominence of the demographic transition. According to the dictionary of demography, the definition of demographic regime is "the particular combination of interrelated demographic characteristics that pertains in a given population". For example, a situation in which fertility and mortality are in balance and where social arrangements maintain this balance is sometimes referred to as a homeostatic regime" (Pressat, 1985:196).

[3] The term homeostatic regime denotes the existence of a system of relationships between the fertility, mortality and nuptiality characteristics of a community and its socio-economic circumstances so that any movement away from an initial position of equilibrium tends to provoke changes elsewhere in the systems which restore the original state (Pressat, 1985:97).

transition: heterogeneity regime; and (3) post-transition: homogeneity regime. The process of the progressive transition or the heterogeneity regime to the post-transition or homogeneity regime is called the period of "convergence". Diffusion plays a critical role in the transition from the progressive transition or heterogeneity regime to the post-transition or homogeneity regime. This could be one reason why the failure to incorporate diffusion into the study of inequality transition in demography has been challenged in recent times (van de Kaa, 1987, 1994; Lesthaeghe, 1995; Goli, 2014). Thus, the pathways of the convergence process are two: (1) Spillover and diffusion effects from developed to developing societies, and (2) Policy interventions to take developing societies to the height of developed societies in terms of socio-economic conditions.

Specifically looking at the hypothesis of this study, we presume that different timelines of the socio-economic and demographic transition have segmented the Indian states and the socio-economic groups into various stages of transition or regimes[4]. A similar process can be observed in the case of the health transition. Thus, in the process of demographic progress from pre-transition homogeneity to progressive transitional heterogeneity regime period, different states improve at a different pace, leading to divergent trends until the reappearance of post-transition homogeneity as shown in figure 1. This is mainly because of a greater propensity for the more well-off states to take up new technology and innovation ahead of the poorer states. In other words, it is just that richer states absorb new health technology, capital investments and purchasing power faster than the poorer ones (Preston, 1976; Deaton, 2003; Wagstaff, 2002). Later, due to the spill over and diffusion effects from richer states to the poorer ones, or due to the government intervention through policy to push forward the lagging states to catch up with the leading states, equilibrium is achieved (Wagstaff, 2002).

Figure 1. Stages of k"inequality life cycle hypothesis" in Demographic Progress



In the following section, we have tested the "inequality life cycle hypothesis" for key demographic indicators. Three selected demographic indicators, viz., IMR, LEB, and TFR represent three critical components of demographic transition in their sequential order: mortality decline, increasing life expectancy and fertility decline. Thus, the results have been presented by the sequence of these components in the demographic transition process.

[4] Many scholars have argued that the trends associated with demographic transition are fueled by a common factor, such as modernization, technology and development which effects rich-poor populations differently (Lesthaeghe, 1995; Mason & Jesen, 1995; Mclanahan, 2004).

IMR

It is the most sensitive and widely used summary measure to understand the overall progress in mortality decline and improvement in population health. Numerous demographic and public health research studies have overwhelmingly concluded that the decline in IMR is mainly a consequence of complementary progress in modern health care and socio-economic advancement. As indicated by Davis in the Change Response model, it is the first component of demographic transition (Notestien, 1945, Davis, 1963). In the recent refreshing exposition of demographic transition, Dyson (2010) believed "mortality decline is the crucial catalyst; once it occurs, the other four components necessarily follow, and most often sequentially because one component generates the next. Mortality decline leads to an increased rate of natural increase, which produces the conditions that cause fertility decline, which in turn leads to increase in life expectancy and population aging".

Though India's IMR is relatively higher (40/1000 by 2014) compared to many developed and developing countries of the world (Goli & Arokiasamy, 2014), in last 60-70 years, on an average it has experienced a phenomenal decline. By analyses of historical trends of mortality, Chandrasekhar (1959, 1972), Bhat et al. (1987), Dyson et al. (2004) and Goli & Arokiasamy (2013) have documented the substancial decline of IMR from 1921 – which accelerated sharply after later half of the 1940s. Though the infant mortality started declining from 1921 onwards, by the late 1970s the decline showed considerable discrepancies, followed by a continuous decline in post-1970s, which led to a steady increase in the natural growth rate and acceleration in population (Goli and Arokiasamy, 2012). However, virtually all the previous studies that assessed long-term trends focused on the average IMR across the states. Though the average across the states shows a continuous decline in IMR, this trend will not help to understand the complex picture of between-state inequalities in the past and present, or to predict their future direction. Therefore, to understand the different regimes and life cycle of between-state inequalities in IMR, we estimated the trends in standard deviation of IMR across the major states of India.

Figure 2. Trends in the between-state inequalities in IMR across the major states in India, 1951-2024

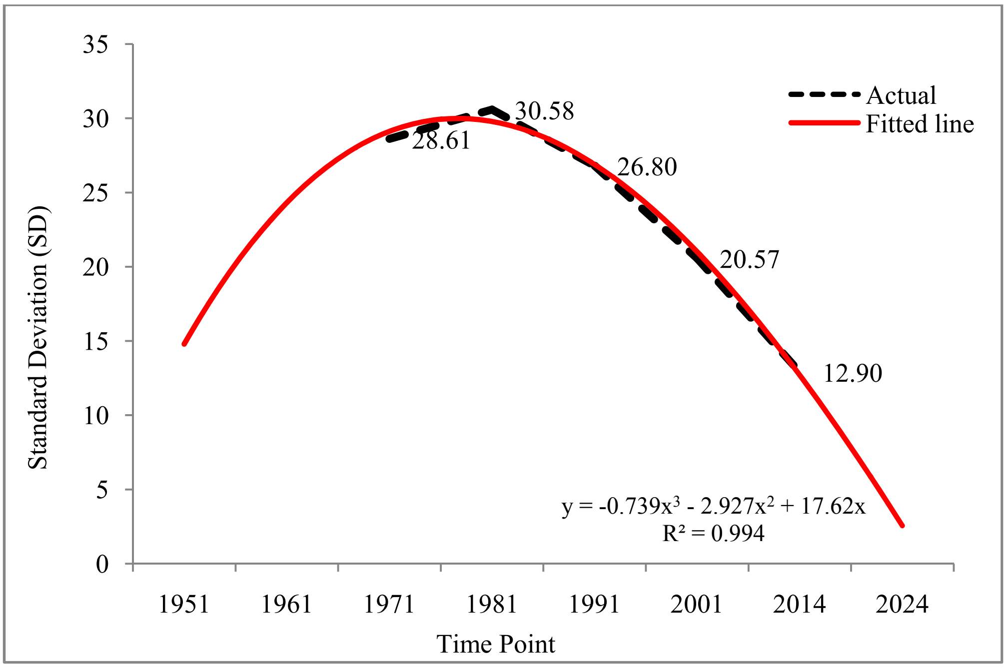


Figure 2 shows the trends in between–state inequalities in IMR across the major states during 1951-2020. The actual estimates of trends in the standard deviation of IMR across the states during 1971-2012 showed rise and fall of between-state inequalities. In 1971, the standard deviation was 28 per 1000 live births, which rose to 30 per 1000 live births in 1981. It declined to 26 per 1000 live births in 1991; after that it has been continuously declining. In 2014, the latest year for which the data is available, the standard deviation in IMR was 13 per 1000 live births. Further, we fit a three order polynomial regression line to the trends for forward as well as a backward projection to assess the past and future trends in inter-state inequalities in IMR. The fitted regression shows an inverted U-shape curve, which indicates that the inter-state inequality was low during the pre-transition period (roughly pre-1970), was at its peak during the progressive transition period (1970-1980), and declined in the catching-up period (post 1980s). Thus, the between-state inequalities in IMR across the major states are following similar paths as the one described in the "inequality life cycle hypothesis."

LEB

It is a widely used aggregate mortality measure in public health research. A sustained decline in the IMR post-1970 has been considered a direct consequence of the improvement in LEB in India and its states (Viasaria, 2004a; Dyson et al., 2004). In the Indian context, many current studies on mortality in general and LEB in particular have focused on the recent trends (post-1970s), typically based on the sample registration system data (Guilmoto & Rajan, 2001; Viasaria, 2004a; Dyson et al., 2004; Dyson, 2010; Saikia et al., 2011; Goli & Arokiasamy, 2013b). On an average, the LEB level in India has more than doubled since independence (Rele, 1987; Guilmoto & Rajan, 2001; RGI, 2007). Though studies have devised indirect methods and measured the historical and geographical patterns of mortality (Bhat & Dyson, 1984, Bhat & Rajan, 1997; Viasaria, 2004a; Dyson et al., 2004; Dyson, 2010), they have neither examined the between-state inequalities, nor identified the different regimes of the inequality life cycle in LEB. Therefore, this study attempts to identify the between-state inequalities in LEB, thereby documenting the evidence for the inequality life cycle regimes.

Figure 3. Trends in the between-state inequalities in LEB across the major states in India, 1941-2020

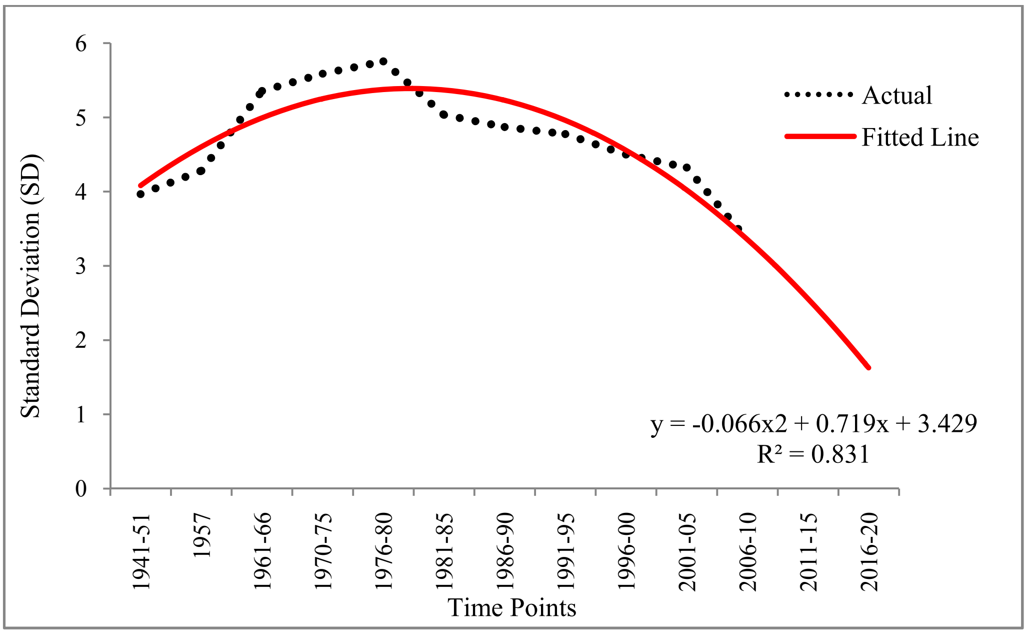


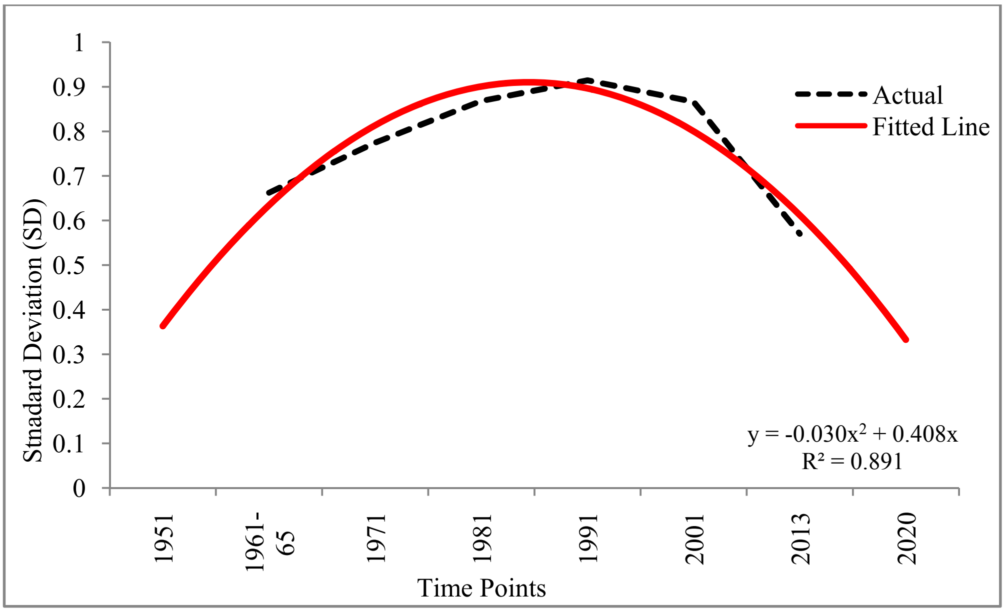
Figure 3 presents the trends in between-state inequalities in LEB across the major states during 1941-2020. Akin to the IMR, LEB also presents evidence for the rise and fall in the inter-states inequalities. Standard deviation in LEB across the major states during 1941-51 was only 3.97 years, which rose to 5.75 years in early 1980. After that, it declined continuously. It was 3.35 years for the period 2009-13, and this is the period for which the latest state level LEB estimates are available. The fitted polynomial regression line to the trends in the inter-state inequalities in LEB during 1941-2020 formed a U-shaped curve, which indicates that the trends in the inter-state inequalities in LEB also confirmed the "inequality life cycle hypothesis." The fitted trend line shows three major regimes: (1) Pre-transition of mortality (before sustained and continued mortality transition) where LEB levels were low and inequality was also low; (2) Early transition period roughly from the early 1970s to mid-1980s when LEB started improving and observed a sustained decline in mortality, the between-state inequalities in LEB were at their peak; and (3) The period of catching-up or transition towards convergence when LEB continued to improve, especially with a fast progress in the laggard states, that leads to reduction in the between-state inequalities. Thus, there is substantial evidence that the between-state inequalities in LEB started returning to their initial levels.

TFR

While the onset of mortality decline started post-1921, the onset of fertility decline started in the mid 1960s. Since then, fertility in India has declined continuously and the pace of decline has accelerated since the 1980s. Consequently, the country is currently passing through the third stage of fertility transition (Rele, 1987; Ram & Ram, 2009; Guilmoto & Rajan, 2001; Arokiasamy & Goli, 2012). Given the scale and diversity of India's population and the provision of voluntary choice with regard to the family size, a decline in TFR from more than six births per woman in 1951 to less than half that level within a span of 30-40 years is a significant achievement. However, changes in fertility on the time scale are not uniform. The decline in fertility has been highly sensitive to mortality scenarios, population health policies, and programme shifts (Rele, 1987; Ram & Ram, 2009; Guilmoto & Rajan, 2001; Dyson, 2010). Akin to IMR and LEB, studies that focused on the inter-state inequalities have mostly measured recent trends, while studies assessing long-term fertility trends have not attempted to understand the pathways of the between-state inequalities. In this study, we have estimated long-term trends in between-state inequalities and identified different regimes in inequality transition by using the "inequality life cycle hypothesis."

The trends of between-state inequalities in TFR across the major states in India during 1961-2020 are presented in figure 4. Similar to both IMR and LEB, the inter-state inequalities in TFR also followed an inverted U-shaped curve. In the pre-transition period (pre-1970s), the between-state inequalities in TFR were less (SD = <0.77 children per woman) as compared with those in the progressive transition period (1981-2001; SD = 0.87 to 0.91 children per woman). However, in the later phase of the progressive transition or convergence period (post-2001), the laggard states started improving at a greater speed which resulted in the catching-up process and led to a decline in between-state inequalities. Akin to IMR and LEB, we have also fitted two-order polynomial regression lines to show the generalized trend pattern of the between-state inequalities in TFR. In the absence of reliable estimates of TFR prior to 1961 and in order to know its future pattern, the polynomial regression line was projected backward till 1951 and forwarded up to 2020 to make prediction of the past and the future trends of between-state inequalities in TFR. The results based on the fitted trend line confirmed a smooth inverted U-shaped pattern. The rise and fall of the between-state inequalities in TFR clearly support the "inequality life cycle hypothesis."

Figure 4. Trends in the between-state inequalities in TFR across the major states in India, 1961-2020



V. Discussion

Though the "inequality life cycle hypothesis" has been discussed in different contexts by previous studies (Kuznets, 1956, Attanasio & Jappelli, 2000; Bourguignon & Morrisson 2002; Dorius, 2008; Easterlin 2000; Madison 1995), its present form was derived in social economics by Firebaugh, (2003) based on the Kuznets framework and it was enriched by Dorius (2010). Along with the long-term trends of between-country income inequalities, Firebaugh (2003) extended it to the between-country inequalities in the educational status. Dorius (2008, 2010 and 2013) used the same hypothesis to explain the behaviour of between-country inequalities in education, gender and demographic indicators. However, efforts to provide empirical evidence of the "life cycle hypothesis" in demographic indicators within countries and between sub-nations were not attempted. Most of the earlier studies on the inequality life cycle hypothesis for demographic indicators were focused on the between-country inequalities (Bourguignon & Morrisson 2002; Dorius, 2008; Easterlin 2000; Madison 1995; Dorius, 2010; Wilson, 2011). At this point of time, its application in a developing country like India is still not clear because of the limited availability of long-term demographic data. Moreover, the socio-economic and demographic patterns are yet to cross the progressive transitional phase. However, by using both direct and indirect estimates of demographic data and with the help of backward and forward prediction of trends, we have extended and successfully tested "life cycle hypothesis" for long-term trends of between-state inequalities in demographic progress in India.

The empirical verification of the long-term pattern of between-state inequalities in India by using the "inequality life cycle hypothesis" offers some stimulating conclusions. This study provides a generalized framework for understanding the behaviour of between-state inequalities in demographic variables. In all the three demographic indicators, the behaviour of between-states inequalities is the same. The between state inequalities were low in the pre-transition phase, rose in the initial phase of the progressive transition and started declining in the later phases of progressive transition. Based on these findings, we can expect that by the time of the post-demographic transition phase, the between-state inequalities will return to their steady state equilibrium. Findings of this study are in tune with those done by Vallin and Mesle (2004) that perhaps best summarized the global transition of health inequalities where "each major improvement in the matter of health is likely first to lead to a divergence in mortality since most favoured segments of the population benefits most from the improvement. When the rest of the population accesses the benefits of the improvement (through improved social conditions, behavioural diffusion, health policies, etc.), a phase of convergence begins and can lead to homogenisation until a new major advance occurs. The entire health transition process breaks down into successive stages, each including a specific divergence-convergence sub-process (Vallin & Mesle 2004:14). A similar argument can also apply to other demographic and health indicators that have logical lower and upper bounds. The findings of the present study support Vallin and Mesle's argument not only in terms of LEB but also in the case of IMR and TFR.

Based on the findings described in this study, we have prepared a set of propositions that not only represent the core components of the "inequality life cycle hypothesis," but also help to understand the progress in long-terms trends in demographic variables. These are: (1) Innovation in agriculture, science, medical technologies, and family planning methods led to a breakdown from the pre-demographic transitional homeostatic steady-state. The time lag between the initial innovation and saturation or full adoption of innovation across the states is the principal, proximate cause of rising between-state inequalities; (2) The saturation effect associated with the bounded variables and catching-up process of policy interventions are the proximate determinants of eventual decline of between-state inequalities in demographic progress; (3) At the national level, the life cycle of inequality – the process of rising and falling inequality – typically takes centuries, not years or decades, to fully unfold; (4) Any alteration or aversion or reduction in the period of the life cycle of inequality will depend on national and state level population and health policies, commitments and affirmative action to push forward the laggard states and speed-up the diffusion and catching-up process for convergence; and (5) In the absence of any "big push", if catching-up depends only on the natural diffusion process, it will take its own course of time, probably centuries, for returning to the steady-state or equilibrium in demographic progress.

With these logical propositions, the projected figures up to 2020 for all the three indicators show that India still needs to go a long way to reach equilibrium under the assumption that it will not have any significant reversal in the progress achieved. Based on the current trends, the between-state gaps may be filled much earlier in IMR, followed by TFR. However, LEB may take much longer time to reach its steady state position. The future reduction in the between-state inequalities in terms of demographic variables mainly depends on how India will improve the efficiency of the ongoing National Health Mission (NHM) in Empowered Action Group (EAG, socio-economically and demographically disadvantageous and high focused states) states where it is already putting in more funds. Thus, improving efficiency of the population and public health programmes may speed-up the catching-up process and avert avoidable inequalities, and thereby reduce the time lag to reach a steady condition in demographic progress in India.

This study has limitations in terms of availability of long-term reliable demographic data for India and its states to assess the entire "inequality life cycle" because the time frame in which these phases of pre-transition convergence to progressive transition divergence to post-transition re-convergence of between-state inequalities occur is much greater than a few decades. Therefore, we failed to analyze and give empirical evidence for the entire "inequality life-cycle" for the demographic indicators. Moreover, currently a majority of states have yet to reach the mature stage of progressive demographic transition. Thus, this study failed to measure the entire post-transition phase, which is necessary to explain the complete cycle of between-state inequalities in the demographic variables. Such a condition forced us to use backward and forward projection data of the demographic indicators which may give a probable picture rather than the actual scenario. The projection based on the assumption of constant improvement in the indicators may not consider the temporary stalls or reversals. Further, the between-state inequalities are sensitive to socio-economic and population policies and they reduce only when the catch-up process happens from laggard states to leading states. Thus, the projected trends based on constant improvement assumption may or may not represent future scenario correctly. Despite the limitations related to long-term accurate demographic data, this study provides a generalized framework for understanding the behaviour of between-state inequalities in the demographic variables in India.

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Appendix 1: Data of IMR across the major states of India, 1951-2024

States	IMR							
	1951†	1961†	1971	1981	1991	2001	2014	2024†
Andhra Pradesh	.	.	106	86	73	66	39	.
Assam	.	.	139	106	81	74	54	.
Bihar	.	.	108	118	69	62	42	.
Gujarat	.	.	144	116	69	60	36	.
Haryana	.	.	72	101	68	66	41	.
Karnataka	.	.	95	69	77	58	31	.
Kerala	.	.	58	37	16	11	12	.
Madhya Pradesh	.	.	135	142	117	86	54	.
Maharashtra	.	.	105	79	60	45	24	.
Orissa	.	.	127	135	124	91	51	.
Punjab	.	.	102	81	53	52	26	.
Rajasthan	.	.	102	108	79	80	47	.
Tamil Nadu	.	.	113	91	57	49	21	.
Uttar Pradesh	.	.	167	150	97	83	50	.
West Bengal	.	.	127	91	71	51	31	.

Note: † These data points are used only for forward and backward projection see the Figure 2.

Appendix 2: Data of life expectancy at birth across the major states of India, 1941-51 to 2016-20

States	LEB					
	1941-51	1957	1961-66	1970-75	1976-80	1981-85
Andhra Pradesh	36.9	37.6	44.1	48.8	53.1	58.4
Assam	36.8	37.5	38.8	45.5	51.1	51.9
Bihar	37.6	38.7	38.0	45.6	51.0	52.9
Gujarat	40.2	41.5	42.7	48.8	52.4	57.6
Haryana	-	44.0	49.5	57.5	54.8	60.3
Karnataka	40.0	39.7	49.3	55.2	56.3	60.7
Kerala	48.3	48.8	55.3	62.0	65.5	68.4
Madhya Pradesh	40.6	37.4	43.7	47.2	49.0	51.6
Maharashtra	39.8	40.3	49.0	53.8	56.3	60.7
Orissa	45.2	38.1	40.0	45.7	49.4	53.0
Punjab	40.9	47.6	53.5	57.9	60.5	63.1
Rajasthan	47.5	39.6	43.6	48.4	51.9	53.5
Tamil Nadu	46.8	38.7	45.1	49.6	53.4	56.9
Uttar Pradesh	38.9	31.6	38.2	43.0	46.2	50.0
West Bengal	44.3	37.4	45.6	46.2	53.3	57.4

Appendix 2 contd….

Appendix 2 Contd….

States	LEB							
	1981-85	1986-90	1991-95	1996-00	2001-05	2006-10	2011-15	2016-20
Andhra Pradesh	58.4	59.1	61.8	63.3	64.1	65.8	.	.
Assam	51.9	53.6	55.7	57.5	58.7	61.9	.	.
Bihar	52.9	54.9	59.3	60.4	61.4	65.8	.	.
Gujarat	57.6	57.7	61.0	63.1	63.9	66.8	.	.
Haryana	60.3	62.2	63.4	64.8	65.9	67.0	.	.
Karnataka	60.7	61.1	62.5	64.2	65.1	67.2	.	.
Kerala	68.4	69.5	72.9	73.5	73.9	74.2	.	.
Madhya Pradesh	51.6	53.0	54.7	56.5	57.7	62.4	.	.
Maharashtra	60.7	62.6	64.8	66.0	66.9	69.9	.	.
Orissa	53.0	54.4	56.5	57.9	59.2	63.0	.	.
Punjab	63.1	65.2	67.2	68.2	69.2	69.3	.	.
Rajasthan	53.5	55.2	59.1	60.7	61.7	66.5	.	.
Tamil Nadu	56.9	60.5	63.3	64.8	66.0	68.9	.	.
Uttar Pradesh	50.0	53.4	56.8	58.6	59.8	62.7	.	.
West Bengal	57.4	60.8	62.1	63.6	64.6	69.0	.	.

Note: †These data points are used only for forward and backward projection see Figure 3.

Appendix 3: Data of total fertility rate (TFR) across the major states of India, 1951-2021

States	TFR							
	1951†	1961-65	1971	1981	1991	2001	2013	2020†
Andhra Pradesh	.	5.51	5.15	4.0	3.0	2.3	1.8	.
Assam	.			4.1	3.5	3.0	2.3	.
Bihar	.	6.31	6.09	5.7	4.4	4.4	3.4	.
Gujarat	.	6.5	5.04	4.3	3.1	2.9	2.3	.
Haryana	.	7.2	5.99	5.0	4.0	3.1	2.2	.
Karnataka	.	5.88	5.15	3.6	3.1	2.4	1.9	.
Kerala	.	5.04	3.79	2.8	1.8	1.8	1.8	.
Madhya Pradesh	.	6.56	5.94	5.2	4.6	3.9	2.9	.
Maharashtra	.	5.66	4.86	3.6	3.0	2.4	1.8	.
Orissa	.	6.07	5.58	4.3	3.3	2.6	2.1	.
Punjab	.	6.01	4.63	4.0	3.1	2.4	1.7	.
Rajasthan	.	6.58	6.15	5.2	4.6	4.0	2.8	.
Tamil Nadu	.	4.8	4.12	3.4	2.2	2.0	1.7	.
Uttar Pradesh	.	6.33	6.33	5.8	5.1	4.5	3.1	.
West Bengal	.	6.72	5.27	4.2	3.2	2.4	1.6	.

Note: †These data points are used only for forward and backward projection see the Figure 4.