Convergence and continuity in Indian fertility: a long-run perspective, 1871-2008

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Introduction

The idea of convergence has a prominent place in both demographic theory and practice. Demographic transition theory predicts that the fertility levels of different countries and regions will converge as they pass through the transition, and most, if not all, population projections assume that fertility will convergence in the medium term. Since fertility has been declining substantially in most developing countries in recent decades, we could suppose that convergence would be easily detected. However, the quantitative evidence for convergence remains tentative. In a review of fertility transition Dorius (2008) found evidence of global fertility convergence only since the 1990s. The apparent paradox at the global level can be resolved by a regional decomposition; Sub-Saharan Africa is still at a very early stage of the transition (the total fertility rate is 5.4, compared with 2.3 in the rest of the developing world and 1.7 in the more-developed countries). Wilson (2011) took this reasoning further and showed that, in most parts of the world, fertility and mortality were strongly linked during the demographic transition. He argued that, "it makes sense to view most demographic change over the past half century as falling along a 'main sequence' of demographic transition. The principal differences between the regions of the developing world lie in when they enter this main sequence and how rapidly they move along it." (Wilson 2011, 384). In this paper we employ some of the statistical methods used by Dorius (2008) and the graphical methods of Wilson (2011) to examine the nature of the fertility transition in India. With one sixth of the world's population, living in a very wide range of circumstances, and with clear regional differences in fertility, India provides an excellent test-bed for an assessment of the place of convergence in the fertility transition. Our intention in the paper is not attempt a definitive study of the topic, but rather to offer a number of general observations that can form the basis for more extended, and more formal, analysis in the future.

Methods

Following an exploratory investigation by Wilson (2001), interest in global demographic convergence has continued through the last decade. Most attention has been given to mortality (Bloom and Canning 2007; Clark 2010; Goesling and Firebaugh 2004; Goli and Arokiasamy (2011) Mayer-Foulkes 2003; McMichael et al. 2004; Moser et al. 2005; Neumayer 2004). The focus on mortality may arise in part because life expectancy is one component in the calculation of the widely used human development index, proposed by the United Nations, and is often used in other calculations of the quality of life (Becker et al 2005; Gidwitz et al. 2010; Kenny 2005; Konya and Guisan 2008; Mayer-Foulkes 2010; Molina 2010; Neumayer 2003). It is also the case that studying life expectancy (an increasing variable with no logical limit) is a natural extension of economists' interest in convergence in income. Fertility change, and its implications, has also been examined through the lens of convergence, (Lee and Reher 2011; Reher 2004, 2007; Wilson 2004; and especially Dorius 2008). However, convergence in total fertility (the main variable of interest) is potentially more difficult to interpret than life expectancy, as the TFR is a decreasing variable with a logical limit, zero, and a *de facto* lower limit to date of around one. Thus convergence in fertility must, of its nature, be an asymptotic process.

In the quest to measure the extent of convergence, demographers are able to draw on an extensive literature, theoretical, methodological and empirical, within economics, where convergence lies at the heart of modern economic growth theory (Barro and Sala-i-Martin 1992, 2004). The classic methods used in economics refer to two distinct but related measures: beta- and sigma-convergence. Beta convergence is said to occur when countries that are laggards in the demographic transition (i.e. with lower life expectancy or higher fertility at the start of a time period) show more movement towards convergence than those further along the process of transition. Sigma-convergence occurs if the variance of the variable under study, usually life expectancy or total fertility, diminishes over time. In addition to these core indicators, scholars have also used a wide range of other measures of dispersion to search for evidence of convergence.

A potentially valuable dimension for demography is the attention given in economics to "convergence clubs", groups of countries that show common trends, even if they differ from more general patterns of convergence. This interest in diverse experiences has led to the hunt for multiple equilibria, sometimes referred to as "twin peaks" when only two distinct distributions are expected (Quah 1996, 1997). The method of choice for the study of convergence in the presence of multimodality has been "kernel density estimates" proposed by Silverman (1981). Bloom and

Canning (2007) have provided an example of the potential of this method for studying health transition, though as yet no systematic study of fertility in this way has been published. In short, the researcher interested in studying convergence has no lack of statistical tools fit for the purpose.

In addition to formal statistical assessments of convergence, Wilson (2001, 2011) has used simple graphical presentation of fertility trends in an attempt to provide an intuitive interpretation of convergence. We also look at differential fertility in the three National Family and Health Surveys.

Although the literature on Indian fertility is vast, to date, there are relatively few detailed studies of demographic convergence in India. Goli and Arokiasamy (2011) have studied mortality, concluding that there was clear evidence of convergence in infant mortality, but only mixed evidence for life expectancy. Their measure of convergence, the dispersion measure of mortality (DMM) for life expectancy, declined down to 1990 but has since increased, indicating divergence. Goli (2011) has also proposed a study of convergence in fertility as part of wide ranging assessment of the determinants of inequality in health.

Data

The data being used in this study is taken from secondary sources, all of which draw on one or more of the following four primary data sources:

a) The Sample Registration System (SRS)

b) The Civil Registration System

c) Indirect/Direct estimates from decennial censuses

d) Estimates from the National Family Health Survey (NFHS) and the District Level Household Survey (DLHS).

The Sample Registration System was thought of as a remedy for the problem of low levels of birth and death registration in India which have continued even after the enactment of the Registration of Births and Deaths Act in 1969, which made registration compulsory. In order to have reliable data on demographic indicators, the Office of the Registrar General of India (ORGI) initiated a scheme of sample registration on a pilot basis in 1964-65, and it took on its fully-fledged shape in 1969-70. Since then the SRS has been providing data on fertility and mortality indicators for the larger states of India. The SRS is based on a dual record system of births and deaths in fairly representative sampling units spread all over the country. The sampling frame is revised every ten years when new census data becomes available. Though earlier sample clusters were replaced

gradually over a period of 2-3 years, recently in 2001, ORGI has replaced all the sample clusters in one go. As the population of India has grown over time, the sample size of SRS has also increased.

The completeness of the SRS has remained a matter of some uncertainty. The ORGI and many independent authors have attempted to assess the quality and completeness of SRS vital statistics. Whatever its problems, it is clear that the SRS is a rich source of demographic data in India. The total fertility rate (TFR) since 1970 is available for India and most of the larger states; two exceptions are West Bengal and Bihar, where the TFR is available from 1981 onwards. Fertility levels in SRS have been found to have been underestimated by 10 per cent (Bhat 1995; 2002). Sampling variations and change in the boundaries of sampling areas may also have created a few discrepancies. While looking at fertility rates of SRS for each year, there are sometimes abrupt changes, which are most likely due to sampling variations. To get rid of abrupt changes which may introduce biases later in the results, TFRs have been calculated for each year using three-year moving averages. The helps to make the data used here smoother and more stable, though, in taking the moving averages so we lose the TFRs for 1971 and 2007.

For the period 1961-66 and 1966-71, we have used the total fertility rates given in Rele (1987) which he calculated using a method he developed based on the child-woman ratios from censuses. We take the TFRs for the period 1871-1961 from Ram and Ram (2009), which are also calculated using Rele's (1987) method. The total fertility rates given by Ram and Ram (2009) represent decades, while Rele's TFRs refer to quinquennia. The SRS fertility rates have also been averaged to represent 5 years. The National Family and Health Survey is a DHS-style survey taken at (more or less) regular intervals: 1992-93, 1998-99 and 2005-06. A fourth survey is in preparation, and once released its results should provide invaluable insights into many of the issues that remain uncertain about fertility in Indian states once it falls below the replacement level.

Data on life expectancy from 1970s onwards is also available in the SRS reports. It has been used in many previous studies and is generally thought to be of good quality. However some questions have been raised about certain aspects of the estimates. In the beginning of SRS in 1970s, the life expectancies are thought to be underestimated by almost one year (Bhat 2002).For the decade of the 1950s we have taken the life expectancy from Wilson (2001), based on the crude death rate calculated by the ORGI and other authors. Data on the population of India's states from 1901 to 2001 has been taken from the various Census reports, with the population of the years between two censuses calculated assuming exponential growth. All the tabulations in this paper

relate to the 15 (14 before 1971) larger states for which data has been most consistently reported. These make up the lion's share of India's total population, with at least 90 per cent of the total at most dates.

Results

Table 1 presents estimates of beta-convergence for the main Indian states going back to the 1870s. The results are given for each decade and, at the bottom, for three broader periods: 1961-2001, 1981-2006 and 1871-2001. The period 1961-2001 can be regarded as the whole of the fertility transition to date, while 1981-2006 covers the time for which unequivocal fertility decline is evident in all states. 1871-2001 is the whole period for which fertility estimates are available. The beta-coefficients indicate the relationship between the fall in fertility over a period and the level of fertility at the start of the interval. If convergence is occurring during a period of declining fertility, then the beta-coefficients will be clearly positive, i.e. high initial fertility is associated with a large fall. The table also indicates the level of statistical significance for each beta estimate. It is immediately clear from Table 1 that there is no strong evidence for convergence. The beta-values are small, and almost all are insignificant at the five percent level. It is perhaps no surprise that the estimates before the 1960s show no convergence, as fertility showed no long-run trend towards decline before the 1960s. However, even in the more recent decades, when fertility has fallen substantially throughout India, the evidence for convergence is negligible.

Table 2 examines information that enables us to see if there is any evidence for sigma-convergence, presenting mean total fertility (both weighted by state populations and unweighted), along with the standard deviation, and other statistics on the distribution of state-level fertility. If convergence is occurring, the standard deviation will decline over time. As with beta-convergence, we see no evidence of the sigma-version. The key indicator, the standard deviation, shows no downward trend; indeed, since the 1960s it has increased, indicating divergence. The mean TFR and the coefficient of variation (the standard deviation divided by the mean, to give a measure of relative variation) are plotted in Figure 1. Far from converging, fertility levels differ at least as much between the states today as they did before the transition. A simple comparison from Table 2 makes this clear. The gap between the highest and lowest levels of fertility among the major states shows no tendency to decrease, actually being wider during the main fertility transition era than before. Table 3 confirms the evidence for widening differentials, showing the Gini and Theil indices of dispersion. To sum up this first part of the analysis, we can say that there is no significant evidence

of convergence in state-level fertility in India, even though fertility has been falling in all states for several decades.

Table 4 and Figure 2 enable us to see more clearly the different regional fertility trajectories that lie behind our negative findings on convergence. The most striking feature is the enduring regional differentials. The gap between the highest and lowest fertility levels remains between two and three for most of the period, even during the era of fertility transition. Moreover, Figure 2 suggests that the fertility decline at the state level can best be viewed as a number of parallel declines. The sheer number of lines on Figure 2 inhibits its interpretation, so a simpler form of data presentation is to be preferred. In Figure 3 and subsequently we present information on four groups of states; these can be regarded as informally-defined convergence clubs. We have based the grouping principally on the recent level of fertility and the date at which fertility decline began. The Groups are thus defined in an informal and *ad hoc* way, and it is not our intention to suggest that this is the only (or even necessarily the best) way in which to categorize India's states.

The groups are made up as follows.

Group 1 consists of the four states with the highest fertility: Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. These four are all found in Northern India and together make up about 40 per cent of India's population.

Group 2 consists of four geographically separated states: Assam (North-East), Haryana (North), Gujarat (West) and Orissa (East). Fertility was generally quite high in these states until the 1960s, but has fallen faster than in the Group 1 states. The group makes up about 15 per cent on India's population.

Group 3 consists of five states which are also geographically spread: Andhra Pradesh and Karnataka (South), Maharashtra (West), Punjab (North) and West Bengal (East), which together have about 35 per cent of India's population. Pre-transition fertility was somewhat lower in these states and decline began somewhat earlier than in Groups 1 or 2. The states in Group 3 now have fertility close to or below the replacement level.

And finally, Group 4 is made up of the two southern states of Kerala and Tamil Nadu, with somewhat less than 10 per cent of the national population. Both states have fertility well below replacement today and have had the lowest fertility of all large states for most of the period since India's Independence in 1947.

Figure 3 makes the nature of the fertility decline much more evident. The four groups began the decline sequentially, in the order 4-3-2-1, at five year intervals from the early-1960s to the late-1970s, and Group 4 consistently had the lowest fertility throughout the 20th century. Most striking of all, however, is the almost parallel pattern of the fertility decline for Groups 2, 3 and 4; only in Group 1 do we see a slower rate of decline. In this context, the lack of convergence makes sense. For most of India, the main difference between the states lies in the date at which sustained fertility fall began, as the pace of decline thereafter is roughly the same in all. And the only exception to the general pattern is in the four large northern states of Group 1, where fertility decline both started later and has proceeded more slowly.

In his consideration of global convergence Wilson (2011) noted that a tight relation appeared to exist between the two dimensions of the demographic transition, mortality and fertility. How far is this true for India? Table 5 gives the life expectancy for each state from 1951 to 2001, while Figure 4 shows the four Groups defined above. As with fertility decline, the parallel nature of the trajectories for the four groups is striking, with the lowest fertility associated with the longest life expectancy (Group 4), and the fertility laggard (Group 1) also showing the lowest life expectancy.

Table 6 and Figure 5 show the total fertility and life expectancy values together. The trajectories across Figure 5 for Groups 2, 3 and 4 lie close together, but Group 1 stands apart, suggesting a different relationship between fertility and mortality transition in the large northern states. At any given level of life expectancy, fertility in Group 1 is higher than elsewhere in India. With this exception, however, the evidence from Figure 5 seems to support Wilson's conjecture that a "main sequence" of demographic transition can be traced, in which there is a tight relationship between progress in health improvement and fertility decline. Given the diversity of economic, social and cultural patterns in the three regions with similar trajectories, the closeness of the lines in Figure 5 seems especially noteworthy.

As a final stage in the analysis we can also consider the extent to which fertility is converging within each state since the early 1990s. The NFHS surveys provide estimated of the TFR for the most commonly examined differentials: urban or rural residence, religion, education and caste, for three dates 1992-3, 1998-9 and 2005-6. These are presented for each of the larger states in Table 7. The states are ordered to correspond to the four groups, running from 4 to 1, with bold lines indicating the groups. The most striking feature of the table, as has been noted by several earlier commentators is the contrast between the northern and southern states. In the South, i.e. both the

two Group 4 states (Kerala and Tamil Nadu) and the two southern states in Group 3 (Andhra Pradesh and Karnataka), there are remarkably small differences in fertility in the differing socio-economic or cultural groups. In contrast, moving north the differentials become greater. Consider, for example, the case of educational differentials. In all the Group 1 states (Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh) fertility for illiterate women in 2005-6 was roughly double that for women with 10 or more years of schooling. In contrast, in all four southern states the gap between the two extreme education categories is limited. Similar, if less pronounced North-South differences are found for the other differentials. In addition to this broad regional contrast, we can also note that the education differentials do provide evidence of convergence. In most states, fertility has fallen more between 1992-3 and 2005-6 for illiterate women, narrowing the differential with the more highly educated. However, urban-rural differentials, and those by religion and caste show less clear-cut trends, providing little or no evidence of convergence.

Discussion and Conclusions

What can we learn from the results outlined above? The first point to make is that there is to date virtually no evidence of significant convergence in fertility at the state level. There are hints of reduced socio-economic and cultural differentials within states, but when it comes to geographical variation there is no statistically significant evidence of convergence. Indeed, the results point to a modest divergence in fertility levels rather than any convergence. This negative conclusion might be thought disappointing; after all few scholarly journals seem in a rush to publish negative results. In this case, however, the lack of convergence is in itself a very significant finding. It indicates that the speed of fertility decline has been similar in most of India, with the state-level differentials mostly due to differences in the level of pre-decline fertility and in the date at which decline began. The main exception to the parallel pattern of fertility decline comes from the four large northern states brought together in Group 1, where decline has been somewhat slower, widening the gap with the rest of India.

A consideration of the joint pattern of health and fertility transition in Figure 5 suggests that most of India is indeed following a “main sequence” of demographic transition, with a tight relationship between the level of life expectancy and the total fertility rate in three of the four groups of states. Again, the exception is Group 1, where fertility is higher at any given level of total fertility than elsewhere. This lends further support to the argument that fertility in much of northern India is following a distinct trajectory from the rest of the country.

A further important result is that fertility decline in almost all of India is ongoing, with only Kerala seeming to have reached a "post-transitional" plateau. Fertility in Kerala has been around 1.7 to 1.9 since the early-1990s, and its trajectory of decline, ending at a clear point of inflection, and followed by roughly constant fertility, is widely taken as a model for projections of future fertility elsewhere in India. Only once fertility has leveled off in this way will convergence occur. Thus, rather than being a major factor in the fertility decline, convergence may be a highly useful tool when it comes to charting India's post-transitional fertility.

However, the fact that fertility in no other state has yet leveled off hints that the Keralan experience might not be as generalizable as is often assumed. For example, if we look at the other southern states of Andhra Pradesh and Tamil Nadu we see as yet no sign of decline ending. The estimates of "wanted" fertility from the NFHS surveys provide an insight in this regard. In Kerala, wanted fertility in NFHS-3 (2005-06) was 1.8; in Andhra Pradesh it was 1.48, and in Tamil Nadu 1.44. Moreover, urban-rural differences were smaller in those two states than In Kerala. There seems at least a good *prima facie* case for supposing that fertility in Tamil Nadu and Andhra Pradesh, and perhaps elsewhere, will fall lower than in it has Kerala, possibly much lower. The implications of such trends would be considerable.

The trends in fertility over the last half century in India do not indicate geographical convergence, but they do point to several very important observations. In at least half of India, fertility is, or soon will be, post-transitional, and demographers need to pay much more attention to what happens then. When interpreting trends and predicting future fertility, research on India has long been able to draw on the demographic transition model (DTM), one of the great generalisations of social science. However, none of the many versions of the DTM has very much to say about the level at which fertility will stabilise at the end of the great decline. It has often been assumed that fertility would level off around the replacement level. However, fertility in several Indian states is already well below this level, and is still falling. In this context, it is time for demographers to pay serious attention to the issue of post-transitional fertility. In a well-known review of fertility transition theories, Cleland and Wilson (1987) argued that, "Fertility transition may occur in two phases: an initial decline which is largely the outcome of the advent of birth control which eliminates excess fertility; and a second phase in which a complex and poorly understood set of factors determine the level of controlled fertility." Much of India is now moving into the second of these phases and, 25 years on, we still have very little idea of what determines post-transitional fertility is still far from being well understood. Moreover, the existing literature on both the causes and the

implications of very low fertility is overwhelmingly concerned with developed countries, especially Europe and developed East Asia.

The European experience over the last half-century provides an interesting set of observations that can be tested against the emerging patterns of low fertility in India. Broadly speaking, Europe can be divided into two categories of countries according to fertility level. Firstly, there is a group of countries in North-West Europe in which fertility has stabilised for at least 30 years only a little below the replacement level (mostly in the range 1.7 to 2.0 children per woman). This group includes the UK, Ireland, France and the Nordic and Benelux countries. In contrast, fertility in more or less the whole of the rest of Europe has fallen much lower, below 1.2 children per woman in some cases, and is still below 1.5 today. When asking what distinguishes the two groups of countries, scholars have pointed to gender relations as a key factor: high fertility, in Europe at least, goes along with relatively high gender equity. In contrast, low fertility seems to be increasingly the situation for countries with more traditional gender roles. The very low fertility in developed East Asia (generally close 1.0), where gender roles are also often sharply defined, seems to fit the same picture (McDonald 2000). So a consideration of the relationship between fertility and the gender dimensions of development will likely be an important part of our emerging understanding of post-transitional fertility in India.

In a recent review of the global demographic transition, Wilson (2011) concluded that we face several fundamental and unanswered questions on fertility. Adapted to the Indian case, these are:

1. How far will fertility fall in India?
2. What can a country such as India, now entering the era of low fertility, learn from the experience of Europe, East Asia, and other regions of well-established low fertility?
3. How can individuals, families, societies and governments, at both state and national level, in the developing world adapt to this new fertility regime?

These questions have scarcely ever been investigated in depth, and they set the agenda for the future work on fertility in India. And, although the analysis of convergence is of limited utility in understanding India's fertility decline to date, the concept is likely to be central to our ability to answer these crucial questions in the future.

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Table 1: Average annual change in TFR regressed on initial TFR in major states of India, 1871-81 to 1991-2001

Year	β	p-value
1871-81	-0.002	0.331
1881-91	-0.006	0.053
1891-1901	-0.001	0.809
1901-11	0.000	0.913
1911-21	**-0.007**	**0.000**
1921-31	-0.005	0.120
1931-41	-0.003	0.552
1941-51	**-0.006**	**0.012**
1951-61	0.000	0.261
1961-71	0.007	0.113
1971-81	0.002	0.468
1981-91	**0.007**	**0.000**
1991-2001	0.000	0.975
1961-2001	0.003	0.188
1981-2006	**0.003**	**0.013**
1871-2001	0.001	0.370

Table 2: Mean total fertility rate and its standard deviation in India: 1871-2001

Year	Un-weighted mean TFR	Weighted mean TFR	Standard Deviation	Weighted Standard Deviation	Coefficient of Variation	Weighted Coefficient of Variation	Minimum TFR	Maximum TFR
1871	6.14		0.66				5.1	7.4
1881	6.34		0.66				5.3	7.3
1891	5.95		0.55				5.2	6.7
1901	6.10	6.11	0.65	0.58	0.11	0.10	5.2	7.1
1911	6.46	6.34	0.82	0.69	0.13	0.11	5.1	7.7
1921	6.05	6.04	0.47	0.45	0.08	0.07	5.2	6.8
1931	5.83	5.75	0.44	0.32	0.08	0.06	5.1	6.8
1941	5.50	5.47	0.52	0.46	0.09	0.08	4.5	6.4
1951	6.06	5.97	0.49	0.41	0.08	0.07	5.0	7.1
1961	6.09	6.06	0.67	0.58	0.11	0.10	4.8	7.2
1966	5.73	6.05	0.69	0.59	0.12	0.10	4.4	6.6
1971	5.05	5.20	0.90	0.94	0.18	0.19	3.7	6.5
1976	4.46	4.66	0.82	0.90	0.18	0.19	3.1	5.9
1981	4.29	4.50	0.91	0.96	0.21	0.21	2.6	5.8
1986	3.80	4.04	0.91	0.97	0.24	0.24	2.1	5.3
1991	3.38	3.62	0.92	1.01	0.27	0.28	1.7	5.1
1996	3.07	3.31	0.89	0.99	0.29	0.30	1.8	4.7
2001	2.85	3.05	0.85	0.95	0.30	0.31	1.8	4.4

Note: 1871-1966, 14 states; 1971-2001 15 states.
SD-Standard deviation; *Weighted -Population weighted.

Table 3: State and population weighted deviation in total fertility rates in major states of India, 1871-2001

Year	Gini	CI 95%		Theil's	CI 95%	
1901	0.054	0.038	0.070	0.005	0.002	0.008
1911	0.060	0.035	0.086	0.006	0.003	0.013
1921	0.043	0.030	0.056	0.003	0.001	0.005
1931	0.028	0.018	0.043	0.002	0.001	0.003
1941	0.045	0.255	0.063	0.008	0.001	0.007
1951	0.035	0.017	0.057	0.002	0.001	0.005
1961-66	0.052	0.040	0.074	0.005	0.003	0.010
1966-71	0.054	0.030	0.073	0.011	0.004	0.022
1971-76	0.103	0.083	0.124	0.017	0.009	0.026
1976-81	0.110	0.093	0.133	0.019	0.013	0.028
1981-86	0.120	0.098	0.139	0.023	0.015	0.034
1986-91	0.133	0.095	0.178	0.030	0.014	0.052
1991-96	0.155	0.118	0.181	0.039	0.020	0.053
1996-01	0.167	0.147	0.189	0.045	0.033	0.063
2001-06	0.171	0.154	0.189	0.048	0.034	0.064

Note: CI is the Confidence Interval

Table 4: Total fertility rate in India and its major states, 1871-2008

Period	Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Karnataka	Kerala	Maharashtra	Madhya	Orissa	Punjab	Rajasthan	Tamil	Uttar Pradesh	West Bengal	India
1871-81	**1876**	5.4	-	7.0	6.5	6.2	5.4	5.3	6.1	6.5	7.4	6.5	6.4	5.1	6.0	6.1	**6.4**
1881-91	**1886**	5.6	-	7.0	6.4	6.8	5.5	5.3	6.8	6.5	7.1	7.3	6.4	5.4	6.1	6.5	**6.5**
1891-01	**1896**	5.5	-	6.7	5.5	6.4	5.6	5.4	5.5	6.1	6.6	6.7	5.2	5.5	6.0	6.6	**6.2**
1901-11	**1906**	5.4	-	6.9	5.9	6.5	5.2	5.3	6.4	6.1	6.7	7.1	5.9	5.2	6.1	6.7	**6.3**
1911-21	**1916**	5.4	-	6.9	7.0	7.6	5.6	5.4	7.1	6.6	6.3	7.7	6.9	5.1	6.4	6.4	**6.6**
1921-31	**1926**	5.5	-	6.7	6.0	6.6	5.7	5.7	6.5	5.8	5.8	6.8	6.1	5.2	6.2	6.1	**6.4**
1931-41	**1936**	5.5	-	5.9	5.8	6.4	5.7	5.7	5.8	5.7	5.1	6.8	6.4	5.4	5.8	5.6	**5.8**
1941-51	**1946**	4.8	-	5.7	6.0	6.4	5.4	4.9	5.6	5.7	5.1	5.6	6.0	4.5	5.8	5.5	**5.6**
1951-61	**1956**	5.7	7.1	6.2	6.6	7.3	6.0	5.6	5.9	6.2	5.8	6.4	6.1	5.0	6.0	6.2	**5.9**
1961-66	**1963**	5.5	-	6.3	6.5	7.2	5.9	5.0	5.7	6.6	6.1	6.0	6.6	4.8	6.3	6.7	**6.1**
1966-71	**1968**	5.4	-	6.3	5.7	6.6	5.6	4.4	5.3	6.3	5.9	5.3	6.4	4.5	6.4	6.1	**5.8**
1971-76	**1973**	4.5	4.9	6.1	5.3	6.3	4.0	3.7	4.3	5.7	4.7	5.0	5.7	3.8	6.5	5.3	**5.5**
1976-81	**1978**	4.1	4.2	5.6	4.8	5.0	3.7	3.1	3.6	5.4	4.3	4.2	5.2	3.6	5.9	4.2	**4.8**
1981-86	**1983**	3.9	4.2	5.6	4.1	4.9	3.7	2.6	3.7	5.1	4.2	3.9	5.5	3.2	5.8	4.0	**4.5**
1986-91	**1988**	3.4	3.7	5.2	3.6	4.2	3.4	2.1	3.5	4.8	3.8	3.3	4.7	2.5	5.3	3.5	**4.0**
1991-96	**1993**	2.8	3.5	4.5	3.2	3.8	2.9	1.7	3.0	4.3	3.2	3.0	4.5	2.2	5.1	3.0	**3.6**
1996-01	**1998**	2.4	3.2	4.4	3.0	3.3	2.5	1.8	2.6	4.0	2.9	2.6	4.2	2.0	4.7	2.5	**3.3**
2001-06	**2003**	2.2	2.9	4.3	2.8	3.0	2.3	1.8	2.3	3.8	2.6	2.3	3.8	1.9	4.4	2.3	**3.1**
2008	**2008**	1.8	2.6	3.9	2.5	2.5	2.0	1.7	2.0	3.3	2.4	1.9	3.3	1.7	3.8	1.9	**2.6**
% Decline 1976-06		54.5	40.0	25.3	48.1	48.1	44.7	50.0	46.2	39.7	46.8	56.3	28.6	55.3	28.8	52.2	40.4
% Decline 1991-06		33.3	22.9	4.5	12.9	32.5	32.3	5.6	34.4	23.9	24.2	32.3	23.9	22.7	17.6	37.5	22.2

Sources: Ram and. Ram (2009), Rele (1987), Office of Registrar General of India. (1971-2008)

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Table 5: Life expectancy at birth [e(0)] for the larger states of India, 1951-56 to 2001-2006

State/Period	1951	1957	1961	1966	1971	1976	1981	1986	1991	1996	2001
Andhra Pradesh	38.1	37.6	44.1	46.1	47.9	53.1	58.4	59.1	61.8	63.3	64.1
Assam	37.7	37.5	-	-	45.5	51.1	51.9	53.6	55.7	57.5	58.7
Bihar	36.5	38.7	38.0	40.0	42.3	46.0	52.9	54.9	59.3	60.4	61.4
Gujarat	40.6	41.5	42.7	44.9	50.2	52.4	57.6	57.7	61.0	63.1	63.9
Haryana	-	44.0	49.5	52.1	52.9	54.8	60.3	62.2	63.4	64.8	65.9
Karnataka	41.4	39.7	49.3	51.8	54.5	56.3	60.7	61.1	62.5	64.2	65.1
Kerala	39.9	48.8	55.3	58.2	61.7	65.5	68.4	69.5	72.9	73.5	73.9
Maharashtra	40.5	40.3	49.6	52.2	53.5	56.3	60.7	62.6	64.8	66.0	66.9
Madhya Pradesh	41.8	37.4	43.7	46.0	46.9	49.0	51.6	53.0	54.7	56.5	57.7
Orissa	36.2	38.1	40.0	42.1	44.0	49.1	53.0	54.4	56.4	57.9	59.2
Punjab	42.2	47.6	53.5	56.3	58.4	60.5	63.1	65.2	67.2	68.2	69.2
Rajasthan	41.3	39.6	43.6	45.9	49.3	51.9	53.5	55.2	59.1	60.7	61.7
Tamil Nadu	39.9	38.7	45.1	47.4	50.3	53.4	56.9	60.5	63.3	64.8	66.0
Uttar Pradesh	36.0	31.6	38.2	40.2	42.8	46.2	50.0	53.4	56.8	58.6	59.8
West Bengal	38.1	37.4	45.6	48.0	49.6	52.0	57.4	60.8	62.1	63.6	64.6

Sources: Rele (1987), Office of Registrar General of India. (1971-2008), Guilmoto and Rajan. (2001), Wilson (2001).

Table 6: Population Weighted TFRs and LEBs for four groups* of states of India; 1901-2001

	Group 1		Group 2		Group 3		Group 4	
	TFR	LEB	TFR	LEB	TFR	LEB	TFR	LEB
1901	6.29	-	6.36	-	6.08	-	5.22	-
1911	6.62	-	6.78	-	6.25	-	5.18	-
1921	6.25	-	6.01	-	6.04	-	5.33	-
1931	5.87	-	5.59	-	5.75	-	5.49	-
1941	5.78	-	5.69	-	5.33	-	4.62	-
1951	6.10	37.65	6.39	38.34	5.96	39.87	5.19	39.90
1961	6.40	39.81	6.45	42.88	5.94	47.52	4.88	48.51
1966	6.36	41.94	5.96	45.05	5.56	49.94	4.46	51.05
1971	6.14	44.32	5.17	48.39	4.60	52.10	3.78	53.83
1976	5.66	47.48	4.56	51.59	3.92	54.80	3.64	57.55
1981	5.56	51.52	4.27	55.46	3.82	59.53	3.22	60.86
1986	5.11	53.98	3.74	56.56	3.44	61.24	2.52	63.59
1991	4.76	57.51	3.34	58.99	2.91	63.15	2.16	66.59
1996	4.46	59.04	3.05	60.80	2.52	64.62	2.04	67.76
2001	4.17	60.11	2.82	61.91	2.25	65.58	1.88	68.68

* See text for derivation of groups.

Group 1: Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh

Group 2: Assam, Haryana, Gujarat and Orissa

Group 3: Andhra Pradesh, Karnataka, Maharashtra, Punjab and West Bengal.

Group 4: Tamil Nadu and Kerala

Table 7: Total fertility rate by background characteristics in India's larger states; 1992-93 to 2005-06

		Residence		Religion		Educational Level Completed				Caste			
State	**Year**	**Rural**	**Urban**	**Hindu**	**Muslim**	**Illiterate**	**<5years**	**5-9 years**	**10 or more**	**SC**	**ST**	**OBC**	**Other**
	1992-93	2.1	1.8	1.7	3	2.3	2.2	2	2	1.4	1.3	2	
Kerala	1998-99	2.1	1.5	1.6	2.5	2.2	2	2.1	2	1.5		1.9	1.9
	2005-06	2	1.7	1.5	2.5			2.1	2	1.3		1.7	2.2
Tamil Nadu	1992-93	2.5	2.4	2.5	2.5					2.8	NC	2.4	
	1998-99	2.2	2.1	2.2	2.6	2.5	2.4	2.2	1.9	2.3	2.4	2.2	1.7
	2005-06	**1.9**	1.7	**1.8**		2.4	1.7	2.1	1.8	2.1	*	1.7	
	1992-93	2.7	2.4	2.6	2.9	3		2.2	2	2.6	3.7	2.5	
Andhra Pradesh	1998-99	2.3	2.1	2.2	2.5	2.4	2.2	1.9	2.2	2.5	2.8	2.3	2
	2005-06	1.8	1.7	1.8	1.9	2.1	1.8	1.8	1.8	1.8		1.8	1.6
	1992-93	3.1	2.4	2.7	3.9	3.4	2.6	2.5	2	3.2	2.2	2.9	
Karnataka	1998-99	2.3	1.9	2	2.8	2.6	2.1	2.1	1.9	2.5	2.4	1.9	2.2
	2005-06	2.2	1.9	2.1	2.2	2.4	2.2	2.1	2.1	2.5	2.5	2	2
	1992-93	3.3	2.1	2.5	4.6	3.7	2.8	1.8	1.5	3.5	3.1	2.9	
West Bengal	1998-99	2.5	1.7	2	3.3	2.8	2.3	1.7	1.4	2.3	2.3	1.9	2.2
	2005-06	2.5	1.6	1.9	3.2	3.1	2.4	1.9	1.4	2.1	*		2.3
	1992-93	3.1	2.5	2.9	4.2	3.7	3	2	2.2	3.4	NC	2.8	
Punjab	1998-99	2.4	1.8	2.1	3.3	3.2	2.4	2.2	1.7	2.9	*	2.6	1.8
	2005-06	2.1	1.9	1.9		3	*	2.1	1.6	2.4	*	1.8	
	1992-93	3.1	2.5	**2.7**	**4.1**	3.5	3	2.5	2.1	3	3.2	2.8	
Maharashtra	1998-99	2.7	2.2	2.5	3.3	3.1	2.7	2.3	2	2.4	2.9	2.2	2.6
	2005-06	2.3	1.9	2	2.9	2.9	2	2.3	1.8	2.1	2.4	2.4	1.4

Table 7 continued: Total fertility rate by background characteristics in India's larger states; 1992-93 to 2005-06

		Residence		Religion		Educational Level Completed				Caste			
State	Year	Rural	Urban	Hindu	Muslim	Illiterate	<5years	5-9 years	10 or more	SC	ST	OBC	Other
Assam	1992-93	3.7	2.5	2.9	5	4.5	3.3	1.9	1.8	2.8	3.7	3.5	
	1998-99	2.4	1.5	2	3.1	2.8	2.4	1.8	1.3	2.6	2.1	1.5	2.4
	2005-06	2.7	1.4	2	3.6	3.4	2.9	2.1	1.3	2.5	2.5	1.6	2.7
Gujarat	1992-93	3.2	2.7	3	3.3	3.6	2.8	2.5	2.2	3	3.3	2.9	
	1998-99	3	2.3	2.7	3.1	3.4	2.9	2	1.7	3	3	2.8	2.5
	2005-06	2.8	1.9	2.4	2.7	3.5	2.3	2.4	1.7	**2.5**	2.5	2.8	2
Haryana	1992-93	4.3	3.1	3.9	6.9	4.7	3.5	3.5	2.8	4.6	NC	3.8	
	1998-99	3.1	2.2	2.8	6	3.5	3	2.5	2.1	3.7	*	3.1	2.5
	2005-06	2.9	2.2	2.4		3.4	*	2.5	2.3	2.9	*	3	2.5
Orissa	1992-93	3	2.5	2.9	4.3	3.2	3.1	2.6	1.6	3.7	2.9	2.8	
	1998-99	2.5	2.2	2.5	3	2.9	2.4	2	1.6	2.9	2.7	2.5	2.1
	2005-06	2.5	1.9	2.4		3.1	2.2	2	1.9	2.3	3.1	2.3	2
Bihar	1992-93	4.2	3.3	3.8	5.2	4.3	3.8	2.7	2.6	4	3.4	4.1	
	1998-99	3.6	2.8	3.4	4.4	3.8	2.9	2.7	2.5	3.9	2.5	3.6	3.1
	2005-06	4.2	2.9	3.9	4.8	4.6	*	3.2	2.4	4.8	*	4	3.4
Madhya Pradesh	1992-93	4.1	3.3	3.9	4.2					4.7	4.1	3.8	
	1998-99	3.6	2.6	3.4	3.4	3.8	3.2	2.3	1.9	3.9	3.7	3.3	2.5
	2005-06	3.3	2.6	3.2	3.1	3.8	3.1	2.8	1.9	3.2	3.8	3.2	2.3
Rajasthan	1992-93	3.9	2.8	3.7	4	3.9	3.3	2.4	2.3	4.3	3.9	3.4	
	1998-99	4.1	3	3.7	4.9	4.3	3.1	2.4	2.2	4.3	4.3	3.8	3.4
	2005-06	3.6	2.2	3.2	4	3.7	*	2.5	1.8	3.6	3.7	3.1	2.8
Uttar Pradesh	1992-93	5.2	3.6	4.8	5.3					5.6	5.9	4.7	
	1998-99	4.3	2.9	3.9	4.8	4.5	3.4	3.1	2.5	4.4	4.8	4.1	3.8
	2005-06	4.1	3	3.7	4.7	4.6	3.3	3.3	2.4	4.5	5.3	3.8	3.2

Source: International Institute for Population Sciences (1995), International Institute for Population Sciences and ORC Macro (2000) and International Institute for Population Sciences and Macro International (2007)**.**

Figure 1: Mean and population weighted TFR and its variation (CV) in India (larger states only); 1876-2001

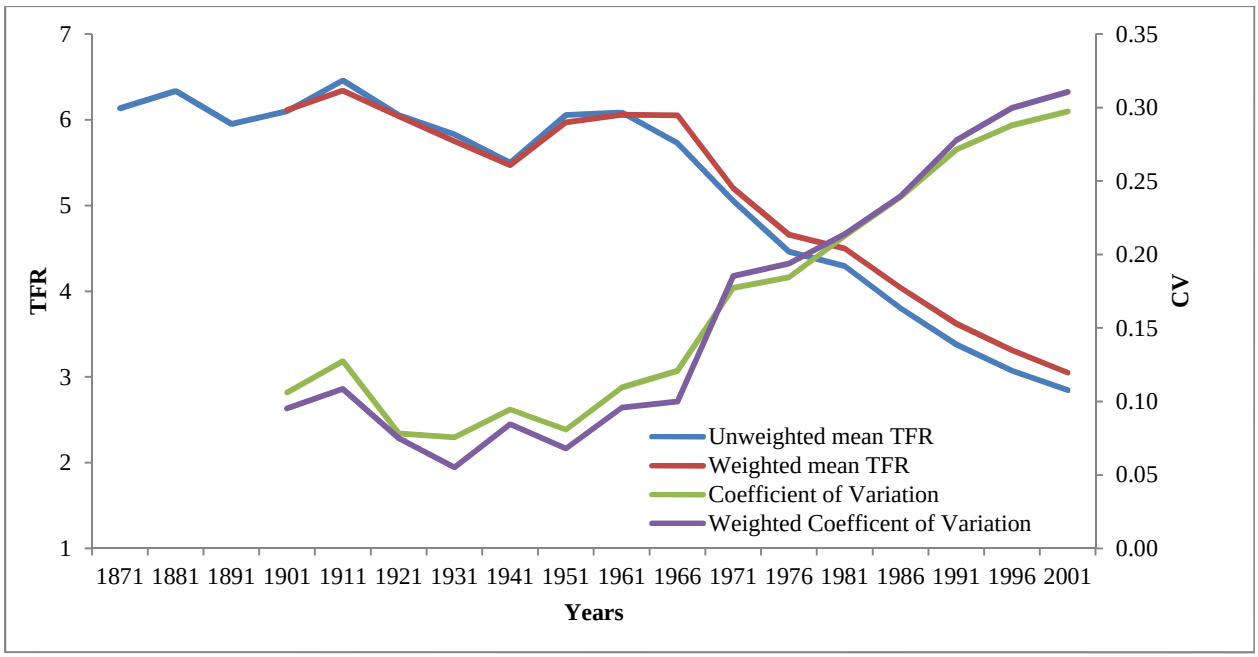


Figure 2: Trends in total fertility rate in major states of India; 1871 to 2001

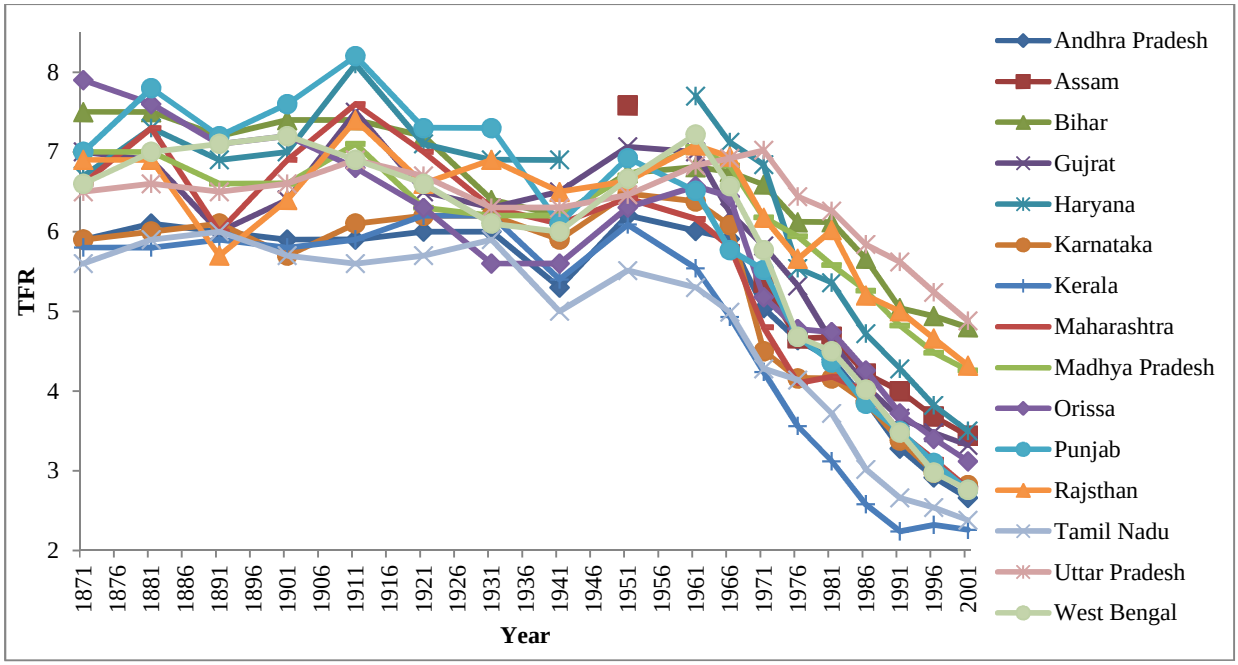
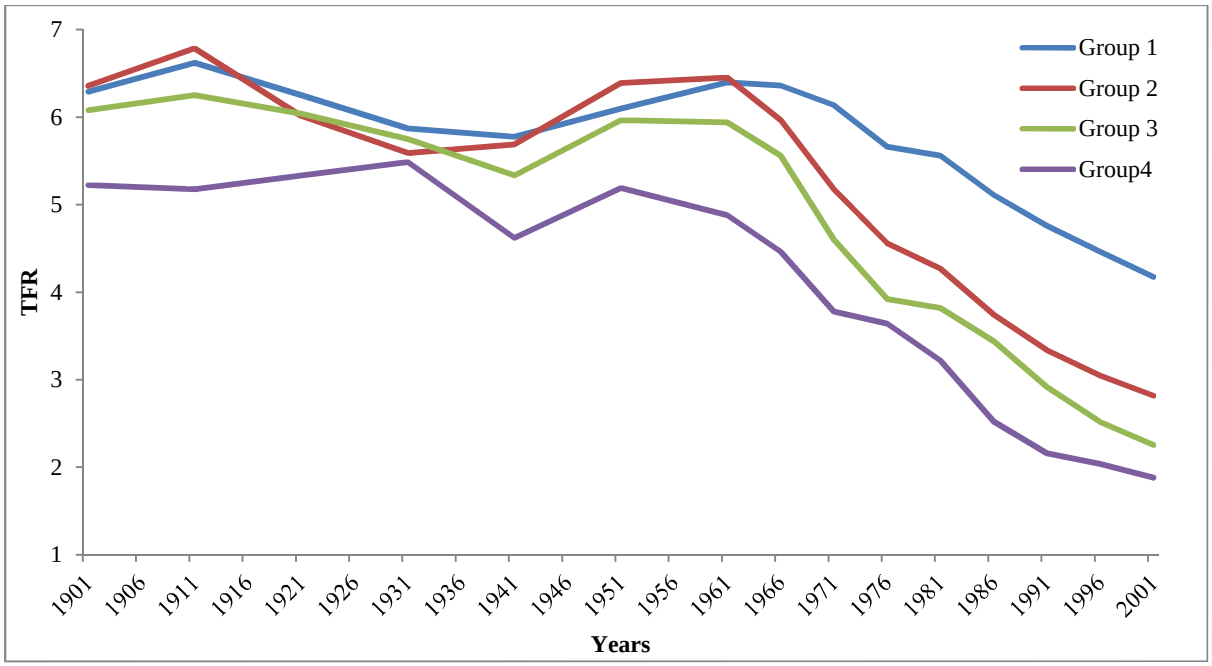


Figure 3: Paths of total fertility rate in four groups*of states of India; 1901-11 to 2001-06



* See text for derivation of groups.

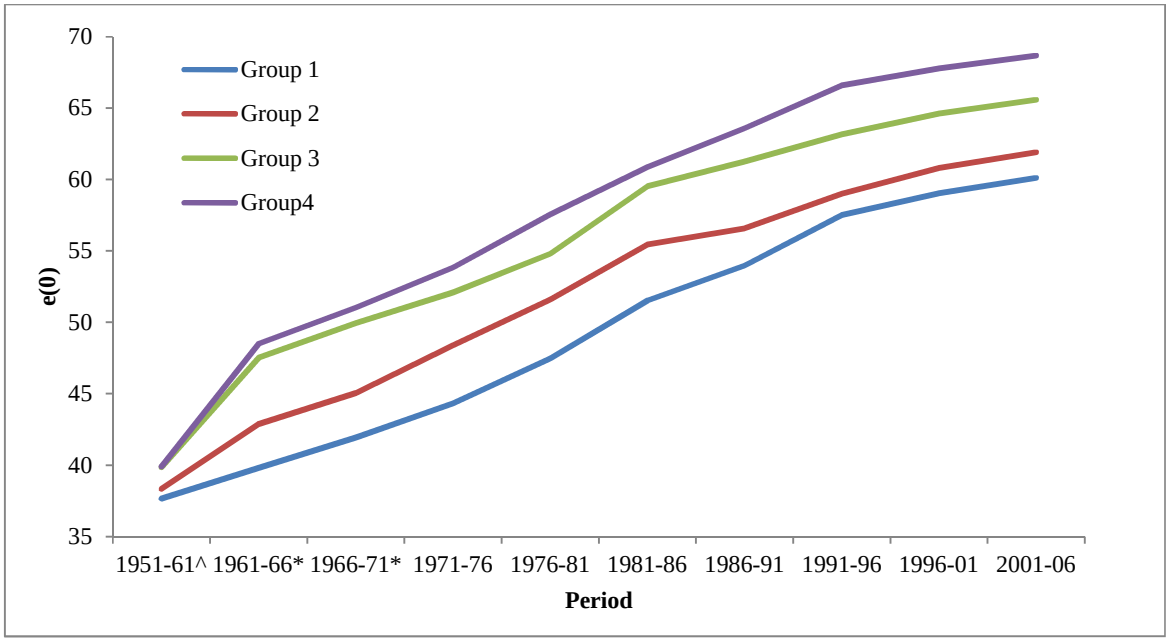
Club 1: Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh

Club 2: Assam, Haryana, Gujarat and Orissa

Club 3: Andhra Pradesh, Karnataka, Maharashtra, Punjab and West Bengal.

Club 4: Tamil Nadu and Kerala

Figure 4: Paths of life expectancy at birth in four groups*of states of India; 1951-61 to 2001-06



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Club 1: Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh

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Figure 5: Combined paths of total fertility rate and life expectancy at birth in groups of states of India; 1951-61 to 2001-06