Indirect Estimation of fertility in India and Major States: An Application of Reverse Survival Methods

Introduction

There have been profound changes in fertility rates in India in past three to four decades. The availability of new census data allocated better citations of the fertility transition in India. This paper contributes to different picture of fertility transition over a time periods. The earliest such method is the Brass P/F method, first set out by Brass (1964). Almost all methods of estimating fertility indirectly have their origins in the P/F ratio method first proposed by Brass (1964). Bhat (1996), using the Reverse Survival Method (RSM), provided district level estimates of CBR and TFR based on population aged 0-6 years from 1981 and 1991 censuses. So far fertility estimates at regular intervals below the state level are not readily available from any other source. A few researchers (Parasuraman and Ram 1988; Das Gupta and Bhat 1995; Guilmoto and Rajan 2002) and the Registrar General of India 1989, 1997 have used different indirect techniques to estimate fertility rates at the district level using census data (IIPS, 2011).

An array to changes in fertility levels and trends in less statistically developed countries, demographers have developed the series of fertility estimation techniques based on data from census Data and surveys (Brass 1975, Moultrie et al. 2012, United Nations 1983). Among the existing methods of fertility estimation from indirect techniques the reverse survival method is one of the most prudent. Based on population data by age and sex collected in one census or single-round survey, the method consists in 'reverse surviving' those no longer present in the population of a given age in order to derive the number of births that occurred *n* years ago, using a set of probabilities of child and adult survivorship and age-specific fertility rates (ASFRs).

Estimates of fertility are key indicators of the demographic status of the population. In general, measures of overall fertility in particular years suffice for trends in these rates over a time period. However, the projection of the population change requires detailed time series of estimates fertility rates that can be used to update the base line population to the current year and extrapolate the fertility into the future. In India, states are demographically heterogeneous. Thus, to produce adequate projection at a state's level requires states-specific series of demographic indicators. The aim of this paper is to produce time-series of fertility estimates (ASFRs).

Objective

To provide time series of RSM based estimates fertility rates for major states and India

Data

The main data source for the present study to derive various fertility and related indicators indirectly are the census using the age sex distribution of the population of the censuses of 1981, 1991, 2001 and 2011

Methods

The principle in the application of the RSM is that: "In a population closed to migration, the population of any age x are the survivors of the births in that population x completed years previously."Basic data requirements for any RSM are: Age-sex distribution of population, an estimate of the life Table survival probability from birth to age x.

Reverse survival is a method for estimating fertility from data collected in a census or single-round survey that can be used even if no questions have been asked about fertility directly. A simulated population was first projected over 15 years using a set of fertility. The projected population was then reverse survived using the Excel template FE_reverse_4.xlsx, provided with Timaus and Moultrie (2012). Reverse survival fertility estimates the age specific fertility rates over a time period.

Estimates of the age-specific fertility rates for the year can be produced by multiplying the proportional rates, $_5f^*_{a,x}$*, for each age group (a) and year (x) by the estimate of Total Fertility for that year.*

Need of the Study

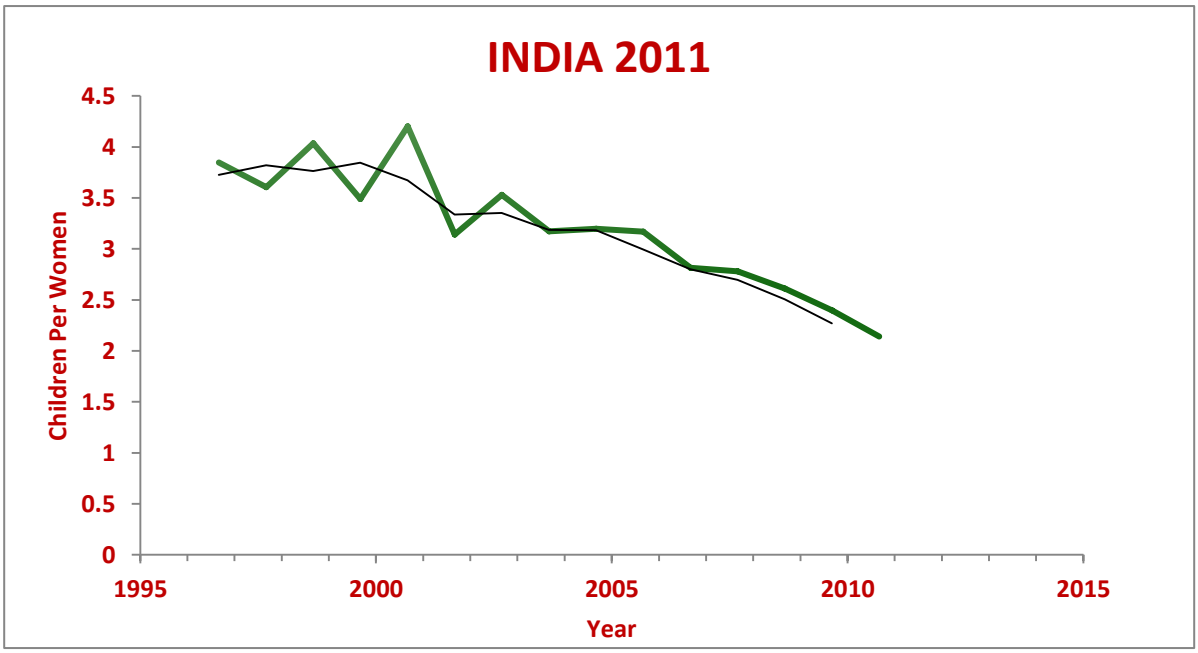
This study is based on times series of fertility rates over a time periods of census data. No one tried to generate the times series of total fertility rates through Indian census data. Previous studies had shown TFR for particular census from different indirect methods of fertility. An application of RSM apply to census data will produce the insignificant demographic information.

A necessity for Indirect measurement of fertility arises due to various reasons: 1)To supplement the direct estimates when they are not available while studying the time trends (such as estimating CBR, TFR indirectly for the period 1901 to 1970s for India and States, districts) of any population; 2) To test the reliability of estimates obtained from other sources and by other methods (may be direct or indirect), 3) To obtain time series of indicators using a specific method such as RSM that are useful in gauzing the fertility transition overtime

Results

The TFR of India is observed to be 2.14 children per women. Replacement level fertility is observed in 11 states of : Andhra Pradesh (AP), Delhi (DEL), Himachal Pradesh (HP), Jammu and Kashmir (J&K), Karnataka (KAR), Kerala (KER), Maharashtra (MAH), Odisha (ODI), Punjab (PUN), Tamil Nadu (TN), West Bengal (WB). TFR between 2.3 to 3.5 is observed in 8 states of : Assam (ASS), Bihar (BIH), Chhatisgarh (CHHATIS), Gujarat (GUJ), Haryana (HAR), Jharkhand (JHAR), Madhya Pradesh (MP), Rajasthan (RAJ), Uttar Pradesh (UP).

Figure 1 Trend in Total Fertility estimated by reverse survival from the 2011 India census



Contribution to fertility decline came from both a rise in age at marriage and fall in marital fertility. But the latter has made a greater impact on fertility than the former. Between 2001 and 2011, TFR fell by 2.06 points. During the course of the transition, the age pattern of fertility has changed substantially. An impressive fall has been seen in the young ages, especially 15-19. The ASFR for this age group declined.

Illustrations of the cases of major states of India

The main purpose of this study was to demonstrate the time series of total fertility rate over a different time periods. The estimates based on RSM methods are within acceptable limits and comparable with estimates of other estimation procedure and surveys. Arising from finding, it is clear that for India as whole fertility rate remained more or less unchanged between recent last two decades and continue to decline thereafter. Even though this study has not recognized an increase the findings indicate that the rate of fertility decline was somewhat reduced.

In Major States of India were used to demonstrate the probable reach of applying the reverse survival method of fertility estimation to generate the time series model of total fertility of existing data sources. These major states were selected for the distinct fertility trends; they signify the large number of alternative fertility figures to which the reverse survival estimates can be compared.

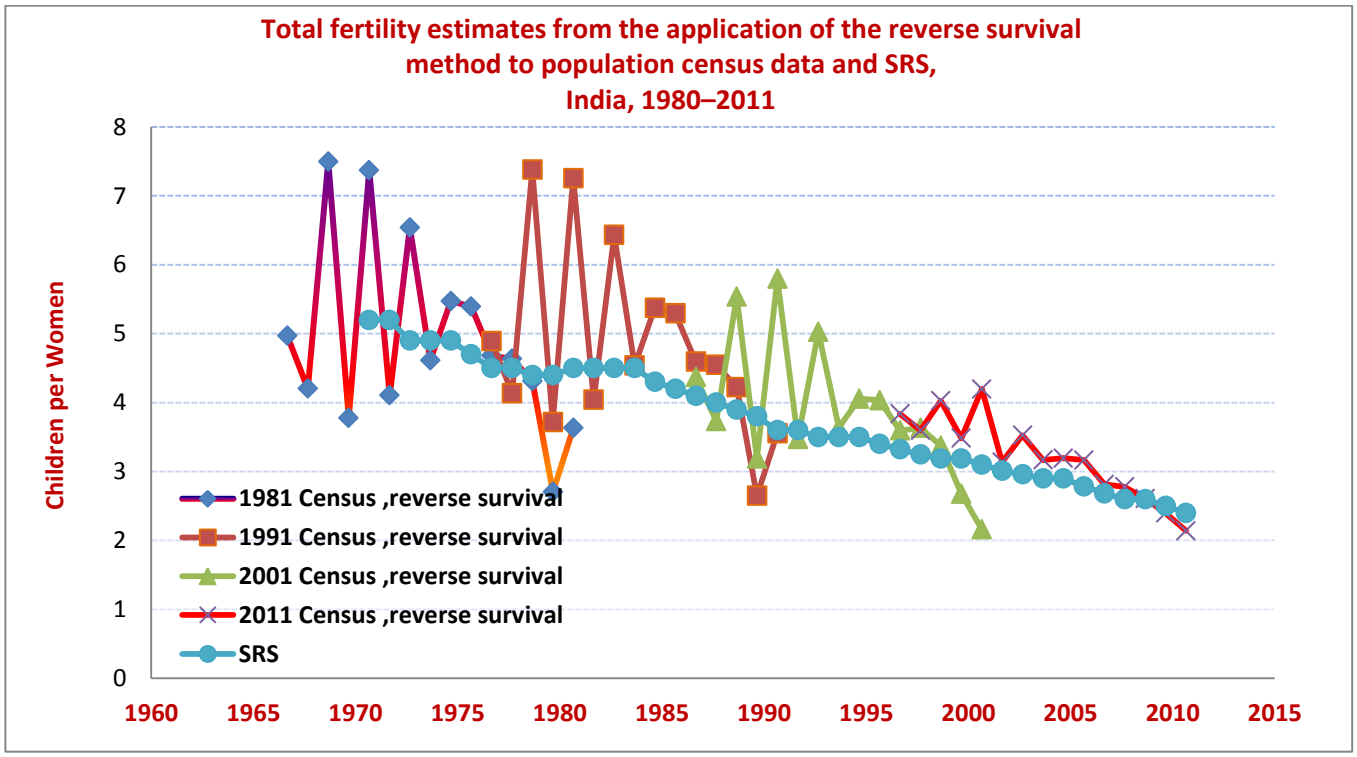
The application of the RSM method in India to demonstrate an ideal case: the quality of the age distribution and the fertility and mortality data is very high, and international migration is almost non-existent. Uttar Pradesh, Bihar, Odisha, Madhya Pradesh and Rajasthan, are less statistically developed states where data quality is more challenging. However these states are far from presenting the most inconsistent data available from alternative sources against which the RSM fertility estimates can be compared. Kerala and Tamil Nadu illustrate a link situation where age distribution, fertility, and mortality

data are of good quality where alternative fertility estimates are also available to assess the presentation of the reverse survival method.

For major states, the population data by single year of age and sex from the fourth most recent population censuses (i.e., 1981, 1991, 2001 and 2011) were used to compute reverse survival fertility estimates. As the population data by age and sex are not smoothed nor interpolated, the fertility estimates reflect the data quality traces in the censuses.

Total fertility rates time series from various sources and estimation methods from 1981 to 2011. Once more, total fertility estimates from various sources and estimation methods are not highly consistent. The major variations recorded in the 1981, 1991 and 2001 census data. In the beginning of 1980 census fertility rates started to decline in the course of successive decades. As well as lowest point of fertility rates in the census of 2011 and consequent fertility decreases are well reproduced by the various series of reverse survival fertility estimates.

Figure 1



Summary:

The reverse survival method of fertility estimation is effortless and prudent method for deriving consistent fertility estimates. Age and sex and hypothesis on the age specific fertility schedule and current morality model has been used to estimate the time series of total fertility rates. To evaluate the reverse survival method of fertility estimation, population was first projected over 15 years. The Excel template

provided with Timaus and Moultrie (2012) is used to projected population below age 15 was then reverse survived to obtain fertility estimates.

Given the simplicity of the method, the contributions of the reverse survival method of fertility estimation to the study of fertility changes are significant. Although significant annual variations in each deacde, the reverse survival fertility estimates are fairly consistent with total fertility estimates derived from sample surveys and other indirect methods and emphasize the contribution of the method to studying fertility trends and levels in periods for which limited information is available. It is not shocking that fertility too varied across different regions/States of the country. During the pre-transition phase, the Kerla and Tamil Nadu had lower total fertility rates (below 5) Guilmoto, 1992; Ram and Ram, 2009. The pathway of fertility differed significantly across major states of India. Fertility transition began early in Gujarat, Punjab and West Bengal in the 1980s and 1990s and tempo of these states is also differed spatially.

Assam, Gujarat and Haryana are very close to replacement level of fertility, but Uttar Pradesh and Bihar have an extensive mode to follow the TFR by 2.1. Yet even in the latter states fertility has declined and the decline is continuing.