Chapter 7

Overall summary and recommendations

7.1 Overall Summary

The objectives of the present thesis are (i) to propose fertility models with all their parameters having clear demographic interpretation, (ii) to investigate cohort fertility patterns of Indian women by their socio-economic characteristics, (iii) to propose simple probabilistic models for the distribution of number children and age at various order births and to use them for quantification of pattern of giving various order births in India and its different regions, (iii) to investigate changes in the dynamics of tubal sterilization practice in India and its different regions and to explain regional variation in fertility level in the country in terms of regional variation in the tubal sterilization practice and (iv) to investigate the relationship between women’s autonomy and their reproductive behaviour.

The need to come up with fertility models with all their parameters having clear demographic interpretation has emerged from the fact that none of the existing fertility models, such as Beta model, Gamma model, Hadwiger model, Peristera and Kostaki models I, II and III, constrained quadratic spline model, etc. have all their parameters demographically interpretable. Since all these fertility models are nonlinear in nature they frequently suffer from problems such as (a) non-convergence of their parameter estimates to a desired solution and (b) existence of alternative solutions (local and global solutions) to the parameter estimates, which will confuse users while choosing the required solution. Given these two problems alongside the presence of un-interpretable parameters, it becomes difficult to judge the validity of parameter estimate(s). On the other hand, non-linear fertility models with all their parameters demographically interpretable and representing those characteristics that could be useful for the practitioners have the following three advantages: (1) their parameter estimates could be judged properly, (2) an initial solution required to obtain the final parameter estimates could be derived from the
empirical fertility data, which would enhance the scope of convergence of parameter estimates to a desired solution and (3) they could be used for indirect estimation of fertility schedules with proper inputs in the form of parameter estimates.

The necessity to investigate cohort fertility patterns of Indian women (objective ii) has originated from the fact that the existing stock of knowledge on fertility levels, trends and differentials, in case of India has been completely restricted to the period approach to fertility change, in spite of the fact that there are few problems associated with the measurement of period (current) fertility. On the other hand, cohort fertility indicators do not suffer from any problem and they correspond to real cohorts of women. Also, it is contended that cohort approach is better for analysis of fertility trends and differentials due to high consistency of fertility estimates in this approach.

Motivation behind working on objectives (iii), (iv) and (v) are respectively (a) most of the existing models of the distribution of number of children and age at various order births are stochastic in nature and they are very rarely used in practice as a result of complexity involved with them, (b) though it is well known that tubal sterilization practice - the method that played vital role in India’s fertility decline - has increased over time but how it has increased over cohorts and its exact role in the regional variation in fertility level in the country is not clear and (c) the relationship between woman’s autonomy and various dimensions of her reproductive behaviour is not very clear from the existing literature. And we believe that testing the role of woman’s autonomy on various aspects of her reproductive behaviour may open new channels through which high fertility in India, particularly in the Central India and the East India, can be brought down to the replacement level fertility.

A special form of the Gompertz (S-G) model, which is of the form

\[ G(t) = F \left( \frac{1}{2} \right)^{\frac{\log(0.95)}{\log(0.05)}} t, \]

with all the parameters having direct demographic interpretation, has been proposed in this study. This model does not differ in structure from the classical Gompertz model. The advantages of the proposed model are:

Chapter 7
1. Parameters have clear demographic interpretations.
2. Unlike the other forms of Gompertz models, this model is least sensitive to its parameters.
3. It can be used for indirect estimation of fertility schedules. Also useful for indirect estimation in a wide range of demographic situations and in various situations in other branches of science where Gompertz model fits well.
4. Since this model is a particular form of Gompertz model, the model has a behavioural interpretation (Goldstein, 2010).
5. Various characteristics of the fertility behaviour could be derived analytically.

A concept called the effective fertility period (EFP), defined as the age interval within which the fertility level of a cohort rises from 5% to 95% of its Cohort Total Fertility Rate (CTFR), has been introduced and is made associated with the S-G model. In fact, parameter \(b\) in the S-G model can be interpreted as the length of the effective fertility period. EFP gives some clues about the impact of some of the intermediate variables like age at marriage and usage of contraception on fertility. For example, the lower limit of EFP sheds light on the age at nuptiality (as births outside marriage are rare and contraceptive use in the early years of marriage is low in India) and the upper limit of EFP sheds light on contraceptive use at higher ages. The S-G model provides good fit to the cohort fertility schedules of high fertility countries like India and low fertility countries such as the USA, Austria, Slovakia, etc. The fit of the S-G model is well comparable with other popular fertility models like Gamma model, Beta model, Hadwiger model, CT model, Peristera-Kostaki model-I, etc. in the context of India.

A six parameter special form of the Gompertz (S-P) model, which allows the parameters in the S-G model to change linearly over cohorts, has also been introduced in this study. The advantages of this model are:

1. all parameters have clear demographic interpretations,
2. a single model is adequate to quantify the characteristics of fertility behaviour of several cohorts for each region,
Overall summary and recommendations

3. there is no need to smooth either the fitted values or the parameter estimates to ensure smooth patterns over cohorts,
4. incomplete maternity histories of several cohorts can be projected forward in time and
5. the year of achieving replacement level fertility in each region can be obtained with a simple assumption that fertility falls linearly over cohorts until replacement level fertility of 2.1 children per woman is attained.

The S-P model has been used to study cohort fertility patterns of the Indian women by their socio-economic characteristics. Probabilistic models for the distribution number of children and age at various order births have also been proposed in this study and are made use of to study timing of various order births in India and its different regions. For better comprehension of tubal sterilization practice in India, models for tubal sterilization schedules (set of age specific sterilization rates is referred as tubal sterilization schedule) are proposed and they are made use of to explore changes in the dynamics of tubal sterilization practice in India and its different regions. A concept called reproductive period averted due to tubal sterilization has been introduced to explain regional variation in fertility level in the country in terms of variation in tubal sterilization practice over different regions of India. To effectively address objective (v), an index of autonomy has been constructed and is made use of to study the role of autonomy of woman on her reproductive choices, in the case of India. Regression models have been made use of to understand (a) factors associated with the level of fertility and (b) role of autonomy of women on their reproductive aspects such as children ever born, ideal number of children, son preference and the usage of contraception. Data from all the three National Family Health Surveys that were conducted in India in the last two decades have been used in this study. Some of the important conclusions that can be drawn from this study are summarised in the following paragraphs.

Fertility fall over cohorts is in progress for all the socio-economic groups, starting from the cohort of women who were born in 1943 (and ultimately have ended their reproductive period in 1993). However, the level from which fertility had fallen,
beginning with the ‘1993 cohort’, and the level to which fertility level is expected to reach by the ‘2025 cohort’, vary widely across the socio-economic groups. Also, the pace of fertility fall over cohorts, in between the above cohorts, is also not uniform. The average number of children born to the women who ended their reproductive period in 1993 has been the highest in the Central India and the lowest in the South India. Fertility decline over the cohorts is expected to be the highest in the North-east India, followed in decreasing order by the South, West, North, East and the Central India. The effective usage of traditional methods along with the increased usage of modern contraceptive methods is related to the fertility decline in the North-east India while the increased usage of modern contraceptive methods has been vital in relation to the fertility decline in the rest of the country. In general, the ones belonging to the disadvantaged socio-economic groups like, uneducated over highly educated, poor over rich, SC and ST over general caste, Muslim over Hindu, rural over urban have higher number children than others. For example, of the women cohort who ended their reproductive period in 1993, uneducated women had on an average 3.2 children higher than the highly educated women who had 2.6 children per woman. Similarly, Muslim women had 1.4 children higher than the Hindu women who had 5.36 children. Likewise, rural women had roughly one child higher than the urban women and women with low standard of living had 1.2 children higher than the women with high standard of living. Also, the rate of fertility fall over the cohorts, in between the cohorts of women who ended their reproductive period in 1993 and those who will end their reproductive period in 2025, is expected to be slightly lesser for the women belonging to disadvantaged socio-economic groups than others. The lower rate of fertility fall among the highly educated women than the uneducated women and the slightly higher rate of fertility fall among the Muslim women than the Hindu women are the exceptions to the above paradigm.

Assuming that any changes in the CTFR are linear across cohorts until it reaches the replacement level fertility of 2.1, only those cohorts of women in the South India who will end their reproductive period after 2024 are expected to end up with the replacement level fertility. The corresponding year of achieving the replacement level fertility for the women in the West, North-east, North, East and the Central India are expected to be
2031, 2037, 2044, 2047 and 2079 respectively. With the same assumption it is expected that the ST women require an additional 37 years over the women of general caste to reach the same level of fertility. Similarly, it is expected that the women with low standard of living require an additional 52 years over the women with high SLI, women of rural areas require an additional 17 years over the women of urban areas, to reach the replacement level fertility. Similarly, it is expected that uneducated women require an additional 52 years over the highly educated women and the Muslim women require an additional 18 years over the Hindu women to reach the replacement level fertility.

Education level of women alone accounts for 15.46% of the total variation in the number of children ever born by age 42 years. On the other hand, region, economic condition, place of residence, work status of woman, religion and caste are accounting for 8.33%, 7.98%, 5.46%, 3.81%, 3.17% and 1.87% respectively of the total variation. About 54% of the gap in fertility level between the Central India and the South India is due to the difference in socio-economic and health conditions of the people in the two regions. Similarly, 65.56%, 78.03% and 16.35% of the differences in the fertility level between the East India and the South India, the West India and the South India, the North India and the South India are due to the differences in socio-economic and health conditions of the people in these regions. Majority of the gap in fertility level between the ST women and the general caste women, between the rural women and the urban women is due to differences in the socio-economic and health conditions among them. On the other hand, socio-economic factors are unable to explain gap in fertility level between the Hindu and the Muslim women. Alongside the changes in fertility behaviour, massive changes in the attitudes and experiences of women such as ideal number of children, son preference, number of child deaths experienced per woman, acceptance of sterilization, which can influence fertility outcomes, have occurred from older cohorts to the current ones, irrespective of the social affiliation of women.

Timing of various order births and the tendency to give higher order births are found varying from one region to other. Typically, first birth occurs around the age of 20 years in all the regions of India. In the East India, it occurs one year earlier than the rest of India. Age gap between successive births is relatively large in the North-east India and small in the West India. The women in the Central India, East India and the North-east India are quite likely to go for second and higher order births, while the women in the South and the West are less likely to do so. Women in the Central India and the East
India are close to one another with respect to the pattern of giving various order births, while the fertility behaviour of women in the West is similar to the women in the North India and then to the South India. Pattern of giving births in the North-east India is little bit different from the rest of India.

It is found that tubal sterilization practice has increased over cohorts in all the regions of India. Also, significant differences in both the magnitude and the timing of tubal sterilization have existed across the regions of India. Age at acceptance of tubal sterilization has decreased over cohorts in all the regions of India, with the exception of the North-east India, where there is a considerable increase in it. Apart from the wide usage of tubal sterilization, the age at acceptance of it is lower in the South India and the West India than in the Central India. Median age at acceptance of tubal sterilization and the peak age at acceptance of tubal sterilization have decreased significantly in all the regions of India, with the exception of the North-east India, where these have increased significantly over cohorts. Majority of the sterilizations took place in a relatively short age interval in the South and the West and in a wide age interval in the Central and the East India. More than 80% of the variation in fertility level across the regions of India and over cohorts is due to the variation in the practice of tubal sterilization.

Level of autonomy of women has a significant influence on her reproductive choices. In particular, with increase in level of autonomy ideal number of children and son preference decreases and the usage of contraception increases. But, the significant positive association between woman’s autonomy and children ever born to her is bit puzzling and is not matching with the findings of earlier studies in this regard.

7.2 Recommendations

7.2.1 On the application of the proposed models in this thesis work (like S-G/S-P/ probabilistic models for the distribution of number of children and age at various order births)

1) If one intends to use the Gompertz model, we recommend to use the S-G model as it has two main advantages over the other forms of Gompertz model namely, (1)
its parameters have clear physical interpretations and (2) the model is relatively stable with respect to its parameters.

2) Usage of the S-P model is recommended in the case of other developed, developing and the under developed countries, provided the assumption in it holds true.

3) Application of the proposed probabilistic models for the distribution of number of children and age at various order births is recommended for other countries also (or contexts).

7.2.2 Policy recommendations

1) Steps must be taken to remove disadvantage faced by some socio-economic groups such as ST and SC women and Muslim women. Economic condition of the people must be improved and education levels, particularly among the females, must be raised. In fact, these are the key channels to achieve fast the replacement level fertility in the country.

2) The experience of the Southern states of India (i.e. the social development along with good exposure to print and electronic media and strong political commitments) in relation to its lower fertility level must be taken into account when formulating policies for reducing fertility levels in other regions. Immediate steps must be taken to meet the unmet need for contraception, especially in the Central India and the East India. Steps must be taken to reduce infant and child mortality levels in the country. Also, strong measures are required to stop marriages before the legal minimum age at marriage of 18 years.
Overall summary and recommendations

3) Print and electronic media should be used more effectively to promote knowledge on various methods of contraception. Steps must be taken so that various methods of contraception are available to the common public.

4) It must be realized that heavy reliance on the tubal sterilization is not the optimum solution to control population growth in the country. Government has to increase its efforts to promote spacing contraceptive methods and they have to make sure that younger married couples get habituated with the usage of spacing methods.

5) As women’s autonomy can positively influence the usage of contraception and reduces son preference and ideal number of children it is recommended that measures must be taken to improve the autonomy level of women in the country.

7.3 Limitations of the present study

Before we finish, few limitations of the present study should be mentioned. First, the study is based mainly on the birth-history data collected in the three NFHSs, quality of which is in debate (see Bhat 1995; Retherford and Mishra, 2001; also see Potter 1977 for general problems in using birth-history analysis to estimate trends in fertility). The second, we have assumed that fertility fall over cohorts is linear, which might not be exactly true. Third, in estimating the year of achieving replacement level fertility we have assumed that the fertility fall over cohorts is linear until the replacement level fertility of 2.1 children per women is attained, the validity of this assumption cannot be verified. Fourth, some of the characteristics of women like occupation, economic condition and place of residence may vary over their reproductive period. But, the present study ignored them.