Fertility Behavior of Indian female Cohorts Crossing Childbearing Age During 1993-2012 by Socio-Economic Conditions: A Model Based Approach

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Extended Abstract

For proper understanding of what changes have occurred in fertility behavior of female cohorts who are crossing childbearing age in the recent period(1993-2012) we need to compare various important characteristics of fertility behavior which can be derived from the fertility distributions of the corresponding cohorts. But generally we just compare cohort total fertility rates (CTFRs) of different cohorts for knowing the changes in this regard. This is just looking at the change in fertility behavior in one dimension only. Though this is the main dimension on which a policy maker is having an eye, there are also some other dimensions which need to be considered for better understanding of how the fertility behavior of female is changing. These new dimensions will also help the policy maker in providing some more clues that will help for better implementation of policies. The present work also focuses on such other dimensions along with the main dimension (CTFR). An easy way of finding out different characteristics of a fertility distribution is to build a suitable model to fertility distribution data and derive various important characteristics of fertility distribution from the fitted model. We all know that the basic objective of any modeling is to provide an alternative to data. We prefer particularly those models that are good enough to explain all the associated variation that are observable in the data, with least number of parameters, each interpretable in physical terms. Keeping this in mind and drawing inspiration from the work of Meyer et al. 1999 we have proposed in our previous work (Samba and Pathak 2008) a special form of Gompertz curve which gives more insight into the problem and is helpful in providing a good platform for comparison of fertility experience of different cohorts across regions and over time horizon. The proposed special form of Gompertz curve has been fitted for each female cohort belonging to various socio-economic groups who are crossing childbearing age during 1993-2012 in India to explain their fertility behavior. For the purpose of the current study we have used some portions of data from all the three National Family Health Surveys(NFHS), i.e. NFHS-1(conducted during 1992-1993), NFHS-2 (conducted during 1998-1999), NFHS-3 (conducted during 2005-2006). The fitted model has been compared with other useful models in this context like the models of Peristera et al. (2007), Hoem et al. (1981), Hadweiger (1944) etc. We find that the model fits well and well comparable with other models. As the proposed model is having additional advantages in terms of parameter interpretations we have proceeded with the proposed special form of Gompertz curve for studying fertility experience of Indian female cohorts by socio-economic conditions. Earlier Guha Roy(1987) and Pillai and Kapoor(1976) have attempted at modeling the Indian fertility experience, but because of the scarcity of data they restricted themselves to period data and by place of residence. The studies have been done for very short periods of two years and one year respectively by the two authors.

Fertility fall in India which started in early 1970's had accelerated since the mid 1980's without leaving any section of the society whether lower or upper caste, rich or poor, educated or uneducated, rural or urban and so on and it had been noted in all the states. This is well documented by different authors (Jain and Adlaka 1982; Preston and Bhat 1984; Rele 1987; Kishore 1994; Das Gupta 1995; James 1999;Bhat and Zavier 1999; Christephe et al 2001; Dev et al 2002; James and Subramanian 2005; Sekher et al 2005). But still there are doubts and debates on fertility differentials; for example, Bhagat and Praharaj (2005) are having a view that the difference in fertility levels between the Hindus and the Muslims is small but its scale is usually exaggerated in the media. In the present work, apart from

parametrising Indian fertility experience by socio-economic groups, we have also tested some of interesting hypotheses on which confusion has existed.

We have defined effective fertility period for a cohort as the age interval in which the fertility level (average number of births)of that cohort reaches from 5% to 95% of the saturation level or total number of births or CTFR. For example, the educated females who are crossing childbearing age in the calendar year 1993 (these are the females who entered into childbearing age in the calendar year 1958) have the effective fertility period (20.67,36.90) which means that 5% (0.17 births) of the total births (2.37) were given by them by age 20.67 years (20 years 8 months 1 day) and 95% (2.25 births)of the total births were given by age 36.90 years (36 years 10 months 24 days) and 90% of the total births i.e. 2.13 births are given in between 20.67 and 36.90 years of ages. The most important finding of the present study are the following. Not only completed fertility level is falling down over cohorts but also effective fertility period is shrinking in the study period 1993-2012. This is due to increased use of contraceptives and sterilization measures at the higher ages and increased age at marriage over subsequent cohorts.
The following figure shows how fertility behavior of the female who are crossing childbearing age during 1993-2012 is changing by level of education. In the figure shown below size of the bubble indicates the length of effective fertility period.

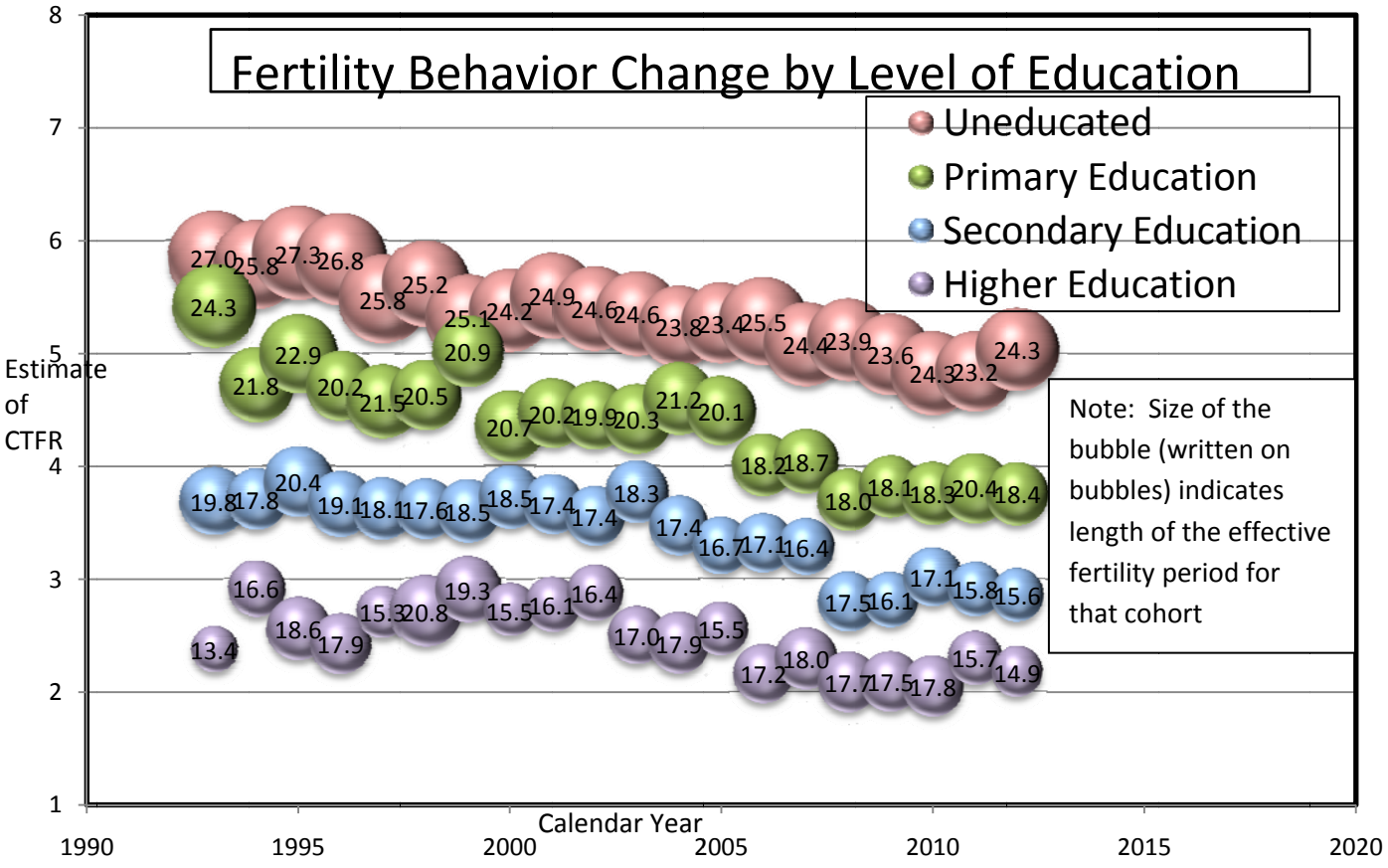

Figure-1: Changes in fertility behavior of cohorts crossing childbearing age during 1993-2012 by level of education

The following table shows the changes that occurred in fertility behavior of females crossing childbearing age during 1993-2012 by various socio-economic conditions. Here we had presented three year moving averages of some important characteristics of fertility behavior.

		Moving average over years	Cohort total fertility rate	Effective fertility period	Length of effective fertility period	Age of attaining half of children
By place of residence	Rural	1993-1995	5.69	(16.52,42.88)	26.35	26.01
		2010-2012	4.99	(16.44,39.69)	23.25	24.80
			Change = 0.70		Change =1.55	Change =0.60
	Urban	1993-1995	5.34	(16.99,40.08)	23.10	25.30
		2010-2012	3.94	(17.22,36.08)	18.86	24.00
			Change =1.40		Change =4.24	Change =1.30
By religion	Hindu	1993-1995	5.33	(16.57,41.79)	25.21	25.65
		2010-2012	4.04	(16.68,37.98)	21.31	24.34
			Change =1.29		Change =3.90	Change =1.31
	Muslim	1993-1995	6.70	(16.52,45.54)	29.03	26.96
		2010-2012	5.56	(16.28,42.82)	26.53	25.83
			Change =1.14		Change =2.49	Change =1.13
	Christian	1993-1995	4.72	(18.013,40.403)	22.39	26.07
		2010-2012	3.17	(17.31,38.53)	21.22	24.95
			Change =1.55		Change =1.17	Change =1.12
	Other religions	1993-1995	4.96	(17.95,40.26)	22.31	25.98
		2010-2012	3.76	(17.75,35.64)	17.89	24.19
			Change =1.20		Change =4.42	Change =1.79
By caste	SC	1993-1995	5.97	(16.62,43.48)	26.86	26.28
		2010-2012	4.72	(16.34,39.48)	23.14	24.66
			Change =1.25		Change =3.72	Change =1.62
	ST	1993-1995	5.69	(16.25,43.74)	27.49	26.14
		2010-2012	4.99	(16.25,41.83)	25.58	25.45
			Change =0.70		Change =1.91	Change =0.69
	Other Castes	1993-1995	5.34	(16.69,41.79)	25.10	25.72
		2010-2012	3.94	(16.82,37.88)	21.06	24.40
			Change =1.40		Change =4.04	Change =1.32
By education	No education	1993-1995	5.83	(16.41,43.08)	26.67	26.01
		2010-2012	4.90	(16.28,40.19)	23.91	24.89
			Change =0.94		Change =2.76	Change =1.12
	Primary education	1993-1995	5.04	(16.78,39.77)	22.99	25.05
		2010-2012	3.78	(16.74,35.79)	19.05	23.60
			Change =1.26		Change =3.94	Change =1.46
	Secondary education	1993-1995	3.75	(18.26,37.64)	19.37	25.24
		2010-2012	2.93	(17.79,33.96)	16.17	23.61
			Change =0.82		Change =3.20	Change =1.62
	Higher education	1993-1995	2.62	(20.67,36.90)	16.23	26.50
		2010-2012	2.18	(21.18,37.31)	16.13	26.99
			Change =0.44		Change =0.11	Change =-0.49
	Low	1993-1995	5.97	(16.26,43.89)	27.64	26.20

By standard of living		2010-2012	4.72	(16.18,43.67)	27.49	26.08
			Change =1.25		Change =0.15	Change =0.13
	Medium	1993-1995	5.69	(16.78,41.64)	24.86	25.73
		2010-2012	4.99	(16.46,39.70)	23.24	24.83
			Change =0.70		Change =1.62	Change =0.90
	High	1993-1995	5.34	(17.37,39.09)	21.72	25.18
		2010-2012	3.94	(17.18,35.29)	18.11	23.70
			Change =1.40		Change =3.61	Change =1.49

As fertility differentials have existed by varying socio-economic conditions of people the need arises on identifying those socio-economic factors which truly contribute to fertility differentials. An identification of such factors may lead to policy prescriptions for narrowing fertility differentials through wider use of contraception and sterilizations among various socio-cultural groups.

As fertility information has been known at least up to the exact age of 42 years so for maintaining homogeneity during comparison among cohorts we have considered number of children born by exact age 42 years. Again for each female of all considered cohorts, we have assumed that for given background characteristics of a female, the distribution of number of children born to her by age 42 years follows Poisson distribution whose mean is a function of the characteristics of that female and the calendar year in which the female is going to cross childbearing age(the time dimension has been used as a surrogate for various development measures that have been taken by the government and other agencies). With these assumptions we have fitted the following Poisson regression to know the impacts of various background characteristics.

$$E(y_i) = e^{(\xi_1+\xi_2 T_1)+(a_1+a_2T_1)ismuslim_i+(b_1+b_2T_1)ischristain_i+(c_1+c_2T_1)isorel_i+(d_1+d_2T_1)isSC_i+(e_1+e_2T_1)isST_i+(f_1+f_2T_1)isurban_i+(g_1+g_2T_1)edu_i}$$

where T_1 =T-1993 , T=1993,1994,…2012.

With our observation that the effects of various considered factors may well be assumed as changing linearly over time (After fitting Poisson regression to each cohort separately to know the impacts of various factors and observing the trends in the effects of various factors which are more or less changing linearly over time we came to this view) we have considered model of above form to proceed with further analysis.

In the above expression y_i is number of children born to i^{th} female, ξ_1 is intercept ξ_2 is the rate at which intercept is changing. $ismuslim_i$ is a dummy variable which takes value 1 if i^{th} candidate is Muslim else it takes 0. T is calendar year in which i^{th} female of our sample is going to cross childbearing age. Similarly, the rest of terms have corresponding meanings. We have included various factors like place of residence, caste, religion, education, economic condition, contraceptive and sterilization practices, age at marriage, region (like north India, central India etc.), empowerment status of women, working status of women etc. step by step in the above regression model to know the specific dimensions that influence fertility. We have also tested the significance of changes in effects of various factors over time on the distribution of number of births.

One of our findings is that after controlling the effects of place of residence, caste, education and economic condition the effect of religion and the change in its effect over time on number of children is highly significant, and in fact, Muslim women have almost one extra birth than their counterpart among Hindu women who have been crossing childbearing age in 1993. The gap has increased to 1.45 births by 2012. The situation is reverse in the case of

Christians. The Christians have been having 0.3 births less than their Hindu counterpart during 1993 and the gap has increased to 0.45 births by 2012.