Regression Estimation of Childbearing Indices from TFR: A Study of India, States, and Its Districts

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ABSTRACT

In the absense of direct estimates of fertility indicators such as total fertility rate (TFR) and childbearing indices, it is customory in the field of demography/Population studies to derive the same using some suitable indirect procedure. In this paper an attempt has been made at first to introduce a new regression methodology for estimating indirectly the maternal childbearing indices from the only given information on TFR. Secondly, using the regression models provided here and using an indirect estimate of TFR of districts in India a set of childbearing indices for disricts in India are derived and they are further used in understanding the fertility transition in India by districts during the time period of 1997 to 2011. Finally, it is shown successfully in this paper by an analysis of the findings that the regression models as well as the estimates of childbearing indices of the district in India are found to be very useful in understanding the fertility transition in India during the study period of 1997 to 2011.

Keywords: Fertility, Regression Estimation, TFR, Childbearing indices, Districts in India.

1 INTRODUCTION

Childbearing indices such as mean age at first birth (MAFB), mean age at last birth (MALB), and mean reproductive life span (MRLS) play an important role in understanding the fertility transition of any country. Horne et al. (1986, 1990) states "The childbearing process should be monitored in developing countries experiencing high population growth rates and high levels of maternal and infant mortality." They, in order to do so, first developed a mathematical model and secondly using the model derived a set of selected synthetic maternal childbearing indices. They further state the childbearing indices thus derived using their mathematical model are "free from age truncation effects" and as an input requires only information on ASFRs. Horne and El-Khorazaty (1987) in their study of the Arab world concludes that "countries in which childbearing initiated at earlier ages also show termination of childbearing at later ages and thus tend to have relatively higher fertility and mortality levels, poorer health conditions, and unfavourable social environments".

In case of India, using the Horne et al. (1990) indirect estimation procedure we may derive various childbearing indices only for major states in India for various years for which the required input information on reliable ASFRs are readily available from the Sample

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registration systems. It is realised no other reliable source provides time series of information on ASFR for states in India. Unfortunately, we cannot obtain the district level childbearing indices for various districts in India using Horne et al. (1990) procedure as we do not have any reliable estimates of ASFRs.

An analysis of the major state level data by Ponnapalli (1996) on childbearing indices indirectly obtained using ASFRS of the NFHS and the Horne et al., (1990) mathematical model indicates that states like Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh comparatively showed a tendency to have childbearing at an earlier age. As noticed by Horne and El-Khorazaty (1987) study, in the above study also it is noticed that these states also have a tendency to end the childbearing process at a later age, probably due to the impact of lower educational levels and early age at marriage of especially females, and impact of other factors like culture and other low socio-economic factors.

In a recent study Mohanty et al. (2016) states that "In 2011, the TFR varied across districts of India; from 5 births per woman in *Khagaria* district in the state of Bihar to 1.1 in *Kolkata* district in the state of West Bengal. While one-fifth of the districts had reached a below-replacement level of fertility by 2011, about half of the districts had a TFR of more than 3."

Thus, it seems a district level analysis of the childbearing indices is very important to have a better understanding of the fertility transition taking place in these bigger states which constitute majority of the districts in India. As it is next to impossible to think about acquiring the reliable district level ASFRs for the districts in India over time or even for a single year from SRS or any other reliable source to derive the childbearing indices using the Horne et al. (1990) mathematical model, there seem a need to develop and use a new methodology that requires minimal input data such as the TFR, for instance.

To the knowledge of the researcher, very few researchers/organizations such as the Office of the Registrar General of India made attempts earlier to arrive at district level ASFRs/TFRs using indirect technique such as the 'P/F ratio method and Arriaga technique' which have their own limitations. It is realised that this published / unpublished information refers to the past census years and provides data for few districts that refers to that particular census. So, these research works may not be of much use for obvious reasons as earlier stated.

The present paper thus aims at introducing and using a set of regression models that provides childbearing indices from the only information on TFR. It further aims at studying *the fertility transition at district level in India during 1997 to 2011, using the above indirectly derived child bearing indices.*

As the input required is only TFR, and further these regression models were developed using the India and major states information on childbearing indices, it is assumed here that they may be very useful in estimating these indices even for districts in India.

Mohanty et al. (2016) study states that "according to the latest Census, India's population was 1,210 million in 2011, accounting for 17 percent of the global population; it current trends continue, India will become the world's most populous country in 2022."

Thus, as India as a whole constitutes 17 percent of the global population, it is also assumed here that the present regression models may be very useful in estimating the childbearing indices for other countries in the Asian region.

While, Horne et al. (1990) regression models were developed by them using as input the data on ASFRs overtime of the world countries, the models presented in this study were developed by Ponnapalli using India and its States ASFRs overtime and a regression model approach and the TFR as the main input variable. Thus, while the purpose of regression models developed both by Horne et al. (1990) and the present study are to derive thee various childbearing indices, they differ mainly (i) in taking the major input in deriving the indices, and (2) the modelling approach they followed. But both the models were observed to give childbearing indices "free from age truncation effects."

The present models thus seem to be much useful in deriving the district level childbearing indices for India. One may also apply Horne et al. (1990) models to estimate district level childbearing indices, if one can get a set of reliable ASFRs for districts also.

The drawback of both the methodologies is that the regression models as a matter of fact to be refined as per the new input available from time to time, to give better estimates than the present models. Thus, experimenting the existing regression models is always advisable.

The remaining part of the paper deals with the sections relevant to data and methodology, results and discussion, conclusions, followed by the references.

2. DATA AND METHODOLOGY

2.1. Regression models for estimating various childbearing indices from TFR

In the estimation of various demographic indicators, indirectly, especially of fertility and mortality, several researchers adopted regression as a best methodology as the simple regression estimation procedure is easy to understand, easy to apply, and in addition requires less stringent assumptions. See for instance, studies made by El-Khorazaty (1992), Horne and El-Khorazaty (1996).

The regression models presented in table 1 below make use of the various childbearing indices overtime derived (i) using the ASFRs (of total areas and of ages 15-19 to 45-49 of the years 1970 to 2015) of different major states and India as a whole that which were collected from various volumes of the Sample Registration System (SRS) reports of the Registrar General of India (RGI), and (ii) using the life table appraoch proposed by Ponnapalli (1996). Further, one can also find the details of the life table appraoch followed here in Appendix II of Yitna Asfaw (2002).

Table 1. Regression models for estimating selected childbearing indices from TFR.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
CONSTANT, INDEPENDENT VARIABLES, and R^2	DEPENDENT VARIABLE						
	Ln (PCW)	Ln (MRLS)	Ln (MALB)	Ln MACB)	Ln (VACB)	Ln (VALB)	Ln (VAFB)
Constant	-.841	.685	2.958	-.394	1.656	-1.576	3.080
Ln (TFR)	-1.604	1.738	-.347	.101	-1.754	5.200	-2.125
Ln (TFR^2)	.280						
Ln (TFR^3)	-.553						
Ln (PCW)		.154	-.087	.041	-.137	.789	-.076
Ln (MRLS)			.285	-.148	1.616	-4.090	2.158
Ln (MALB)				1.163	.831	2.241	-7.342
Ln (MACB)					-.880	-2.198	11.341
Ln (VACB)						2.882	-.420
Ln (VALB)							.090
Ln (MAFB)							-4.215
R Square	1.000	.965	.948	.991	.998	.956	.988

Source: Prepared by the first author Ponnapalli

Note: (1): All the coefficients of various independent variables and constant terms given in various models above are observed to be statistically significant having a t - statistic value of more than 2.0;

Note: (2): MAFB = MRLS - MALB;

For instance: Model 3: ln (MALB) = (2.958) +(-.347) *ln (TFR)+(-.087) *ln (PCW)+(.285) *ln (MRLS)

Note 3: In the above models: 'Ln' indicates the natural logarithm; TFR = Total fertility rate = Sum of ASFRs of ages 15 to 49; PCW = Percent childless women; MAFB = Mean age at first birth; MALB = Mean age at last birth; MRLS = Mean reproductive life span; MACB = Mean age at childbearing; VACB = Variance of age at childbearing; VALB = Variance of age at last birth; VAFB = Variance of age at first birth

Definition of the selected indicators in the above models:

- **Total fertility rate (TFR):** The sum of the age-specific fertility rates of the ages 15-19 to 45-49 in a given year. It represents the average number of children a woman would have if she experienced, over her reproductive span, the age-specific fertility rates of the given year.

- **Mean age at first birth (MAFB):** It is the mean age of mothers at the birth of their first child if women were subject throughout their lives to the age-specific fertility rates of first order births in a given year.
- **Mean age at last birth (MALB):** It is the mean age of mothers at the birth of their last child if women were subject throughout their lives to the age-specific fertility rates of last order births in a given year.
- **Mean age at reproductive life span (MRLS**): It is simply computed as the difference between the MAFB and MALB
- As you may observe, the above childbearing indicators are defined similar to TFR and so also more refined.

It is noticed, to derive the childbearing indices using the seven regression models given in table 1 above, one may need only the information on the TFR of the study unit namely that of India, states and districts, under consideration.

It is realised that, given a reliable estimate of TFR, at first, using the above regression models in Table 1, one may get an estimate of the PCW. Using the estimates of TFR and PCW and the regression model concerned, secondly one may estimate now the measure of MRLS (Mean reproductive life span). Similar is the case for estimating other child bearing indices.

It is to state, the above regression models were developed by Ponnapalli, the first author after a thorough experimenting; and further seen the above models were developed using natural log (ln) function of the original variables for obvious reasons. As a matter of fact, all the fertility variables, including the one used in these models were observed to be well correlated with each other by any demographer/ researcher for obvious reasons, the very fact that lead the first author for further development of the present models. For obvious reasons, no correlation results were presented in the paper. But all the above models as reflected by the R-square values presented here are seen to be statistically significant. No attempt is made to provide the other usual parameters of the regression models namely t-statistic of the coefficient and also the F-values of the models for convenience of the presentation but seen to be statistically significant in almost all of the models presented here. For a set of various estimates of childbearing indices corresponding to the time periods 1997 and 2011 of various states and India, for instance see Appendix Table 1.

2.2. TFR (RSM) and its Derivation

This input 'TFR' information at the district level, states, UTs and India as a whole for the two time periods namely of 1997 and 2011, under consideration are derived indirectly using the basic reverse survival method and a software program namely "***FE_reverse.xlsx 483.38 KB***", recently proposed by Timaeus and Moultrie (2013) and further provided in detail in Ponnapalli and Akash (2018). For convenience of the readers a brief discussion is provided here about the details of the method and data in use.

Thus said, the procedural details of estimating TFR, named the indicator here henceforth for convenience as TFR (RSM), from the given single-year age-sex distribution of the population and the by the basic reverse survival method using "***FE_reverse.xlsx 483.38 KB***" of Timaeus and Moultrie (2013) is in brief, in few simple steps, as follows:

1) RSM as a matter of fact, is based on the rationale 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." Thus "reverse surviving" the population to its birth year provides the number of births.
2) Dividing the births thus obtained by the mid-year total population provides the crude birth rate (CBR) and dividing the births by the mid-year female population in the reproductive ages provides the general fertility rate (GFR).
3) Using the same logic and using some more inputs as specified by Timaeus and Moultrie (2013) one may also estimate the age-specific fertility rates (ASFRs) and the most sought-after summary measure of fertility the total fertility rate (TFR) or the TFR(RSM).

TFR (RSM) estimates used in this study were derived by the second author Akash Kumar using the above said methodology (See Ponnapalli and Akash, 2018). Table 1 in Appendix, columns 2 and 3 also provides the TFR (RSM) estimates for 1997 and 2011, for India and its various states. The validity of the present TFR (RSM) estimates were tested by comparing them with that of the TFR estimates earlier provided by Guilmoto and Rajan (2013) (see Fig 1).

An observation of figure 1 indicates that for the year 2011 both the methods gives very close estimates of TFR. The observed R-Square value of 0.96 between the two is seen to be highly significant. Thus, it is assumed here that the time series estimates of TFR (RSM) prepared by the present researchers for other years are also valid and useful for estimating the required childbearing indicators overtime at the district level using the only information on TFR.

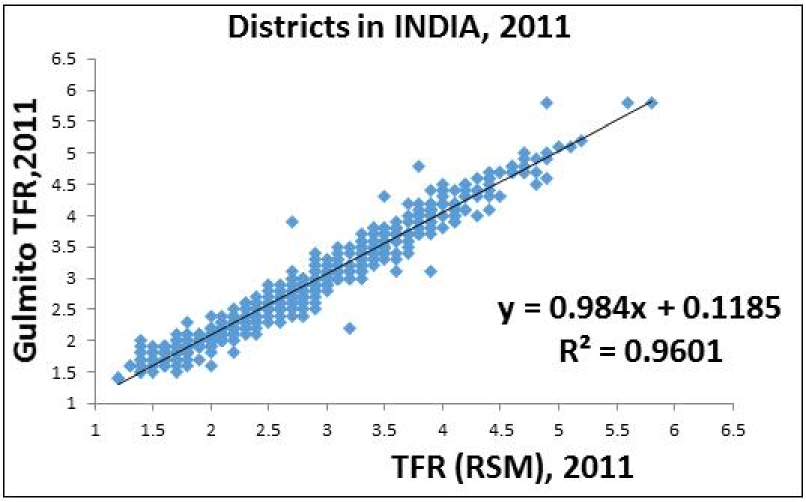


Figure 1. Comparison TFR (RSM) of 2011 with TFR 2011 of Guilmoto and Rajan (2013).

As a matter of fact, TFR (RSM) used in this study uses the 2011 census single year age-sex distribution data of districts, states and India; and the age patterns of ASFRs of 2011 of various states and India of SRS as a whole and the Coale-Demeny West Model life tables, and provides time series estimates of TFR (RSM) for various units for the time periods 15 years earlier to the present census of 2011 that corresponds to the years 2010.67 to 1996.67. For convenience of representation we refer 1996.67 as 1997 and 2010.67 as 2011. Thus, they may observe to be not corresponding to the exact years namely 1997 or 2011. As a matter of fact, similar is the case referring to the TFR estimates made by Guilmoto and Rajan (2013). Present RSM approach followed in estimating TFR (RSM) is observed to give time series estimates of values and thus seen to be very useful unlike the previous simple versions of the same methodology. This procedure proposed by Timaeus and Moultrie (2013) now seen to give plausible estimates of TFR however they may not be said to be almost the estimates of TFR derived using another refined version of the reverse survival method namely the Own-Children Method (OCM). It is one way seen to be simpler to apply unlike the OCM that requires more input data than the present procedure and also, a specific software program that was earlier prepared by the East West Center.

3. RESULTS AND DISCUSSION

This section of the paper at first presents the state level results by means of radar maps that were prepared using the data given in table 1 in Appendix. Secondly, district level results were presented by means of India by district maps.

Radar maps, as well as India by district maps, simple bar diagrams presented in this section of the study definitely gives a better opportunity to gauze the reality of distribution of the indicators over the space, various units of observation, over the time periods under consideration in a comparative perspective.

3.1. Understanding fertility transition in India at the state level during 1997 to 2011: Using various indirect estimates of childbearing indices

As stated before, Appendix Table 1 provides the indirect estimates of various childbearing indices for 1997 and 2011 of all major states in India. Using the TFR (RSM) as an input, various regression models used here simply translated them into corresponding various childbearing indices.

An analysis of the results (See radar maps, data in the Appendix table 1) indicates that, for instance, in case of India, it is realised that as expected while the indices of MAFB and PCW increased from 1997 to 2011, all other indices namely MACB, MALB, MRLS declined during the same period with a decline in the input variable TFR (RSM). It seems an increase in the education level of women overtime and as a consequence an increase in the age at marriage age of women, use of temporary contraception as a consequence postponement of birth might have led to an increase in the values of MAFB over time. Similar way one may explain that several factors might be responsible for an increase in the PCW and a decline in the other indicators. The extreme (maximum and minimum) values of various estimates provided here in Appendix Table 1 indicates that they may be found in fewer states namely Kerala, Tamil Nadu, and Andhra Pradesh (combined states of present Andhra Pradesh and Telangana State) on the one hand and in the states of Uttar Pradesh, Bihar, and Jammu and Kashmir on the other hand in case of maximum values to say for instance.

It is stated that it is beyond the scope of the present study to provide detailed reasons for the changes overtime as the aim here is to derive the estimates and not to discuss the determinants of the estimates in detail.

As stated above, for a better understanding of the fertility scenario over time in comparative perspective at a glance of different states, radar diagrams were prepared for each of the indicators and were presented in figure 2 (A-F).

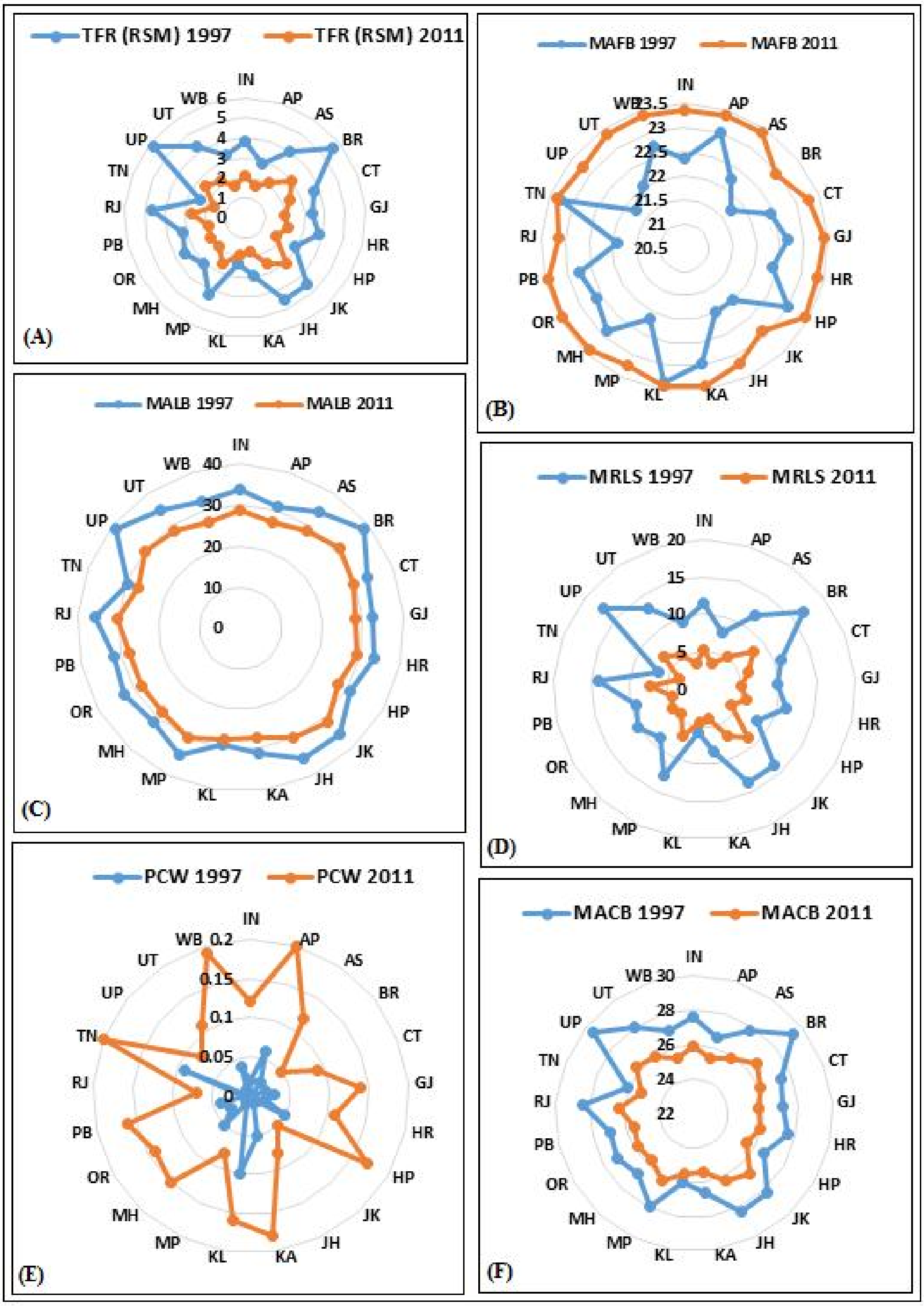


Figure 2. Radar Charts showing progress in major States in India, A) from 1997 to 2011 of TFR (RSM); B) from 1997 to 2011 of MAFB; C) from 1997 to 2011 of MALB; D) from 1997 to 2011 of MRLS; E) from 1997 to 2011 of PCW; and F) from 1997 to 2011 of MACB.

A Radar Chart is a graphical method devised to display multivariate data by means of a two-dimensional chart of three or more quantitative variables represented on axes starting from the same point. Radar charts shown below depicts the progress made in the fertility transition during 1997 to 2011 by means of different childbearing and related indices namely that of TFR (RSM), MAFB, MALB, MRLS, PCW and MCB of major states of India. Similar diagrams may be made in case of smaller states and districts of each state in India. It is assumed that a study of the state level variation in the indicies can reflect the below-state level scenario also. However, district level variation in the above indices may be better understood by means of various all India by districts of 2011 maps shown in the next sub-section.

A keen observation of the radar diagrams in figure 2 (A-F) reveals that

1) The states of Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Jharkhand and Uttarakhand have comparatively highest fertility in 1997 but have shown a decline in their values by 2011.
2) The mean age at first birth and other child bearing indices displayed in the diagrams of these above-mentioned states as expected shown a distinct pattern when compared to those states where the fertility is comparatively low in 1997 and as well as 2011.
3) As expected MAFB and PCW increased over the 1997 to 2011 period of all of the States due to obvious reasons. This is just because we may see 2011 value of these indices of all states outside and the 1997 values inside, with a decline in TFR over time.
4) Similar way one may notice a decline in the values various indicators (except for MAFB and PCW) of the each of the state over time from 1997 to 2011 with a decline in TFR over time.
5) It is to conclude that all the childbearing indices behaved as expected with a progress in development and with a simultaneous decline in TFR.

As stated, a study of district level variation in these indices by means of India by district map is expected to give a better picture and so the following section with further details.

3.2. Understanding fertility transition in India at the district level during 1997 to 2011: Using various indirect estimates of childbearing indices

Various indirectly estimated childbearing indices at the district level (not given here) were shown here by means of India by districts maps. Each map consists of 640 districts (as of 2011 census) and the districts in occupied JK by Pakistan shown here in the map by NA (Not available).

For each of the childbearing index a convenient range of variation is decided and the range thus selected is used in showing districts in various maps. In each of the map each range is shown by a different colour for better visualisation. Mapping the childbearing indices at districts level thus gives an opportunity for a better visualization and understanding of the variations in the index over time. But it seems good at first to show the number of districts involved in each of the sub-category of each index by means of a simple bar graph as shown in figures 3.1 to 3.6 below and have a discussion to bring meaningful conclusions. Mapping however is interesting and useful it has its own limitations. For instance, using of a light colour as in case of TFR (RSM) for range 4.1 to 5.0 seem to confuse some readers as the light colour used here almost coincides with the white colour used for NA category of JK occupied area. Thus, supplementing the map information with the frequency distribution of districts of the relevant map felt here by the researchers may give a better idea. Below is a small attempt in this angle. All the maps presented here were painstakingly prepared by the second author Akash Kumar using relevant statistical packages available at the computer centre of the IIPS, Mumbai.

Figure 3.1 and map 3.1 depicts the distribution of districts in India by range of variation in TFR (RSM). As expected, TFR (RSM) declined from 1997 to 2011 in each of the district of all states, UTs in India. A dramatic shift in the distribution of districts from 1997 to 2011 (well noticed from figure 3.1 and further seen from map 3.1) perhaps gives the indication that fertility transition is fast in progress in majority of the districts, especially of the northern states of Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, during the study, period of all States/UTs in India when compared with the districts of southern states especially of Kerala and Tamil Nadu which are already well in progress in their fertility transition in the study period.

Figure 3.2 and map 3.2 depicts the distribution of districts in India by range of variation in MACB. As expected, range of variation in MACB declined from 1997 to 2011 in each of the district of all states, UTs in India. A concentration of majority of districts in India in the MACB range of less than average age of say 28.0 years gives the indication that many of the women in India even at the district level prefer to control their fertility to fewer reproductive years of their life and prefer to have all their births before they crossing the average age of 28 years or so. It gives the indication that a progress in the socio-economic development led to an increase in the MACB overtime and it is well reflected in the figure 3.2 and map 3.2.

Similar way we may interpret the results depicted in figures 3.3 to 3.6 in combination with information shown in maps 3.3 to 3.6 that depicts variations in the range of distribution of districts in India by various childbearing indices. As the figures and maps are self-explanatory and further the interest here is not to concentrate much in giving an explanation for the causes and consequences of a fertility decline, except for showing the indirect estimates and their usefulness in understanding the fertility transition overtime at the district level, the interpretation part is limited here to few points as explained above.

A general conclusion that can be brought out from this section of the paper is that all the districts in India also experienced a dramatic decline in their fertility levels during the study period of 1997 to 2011, and that were well captured here by means of various childbearing indices also, however they were estimated using indirect estimation procedure under experiment. The district level variations of various indices undoubtedly seem to corroborate the trends at the state level. Thus said, the methodology used here that requires only input data on a reliable estimate of the TFR for the study unit under consideration seems to be very useful for a study of variations in fertility at sub-state level units such as districts in India.

This methodology may further be used and experimented, using TFR estimates derived from other sources, in the recent times at the district level in India, from sources such as National Family Health Survey (NFHS), District Level Household and Facility Survey (DLHS) and Annual Health Survey (AHS) surveys.

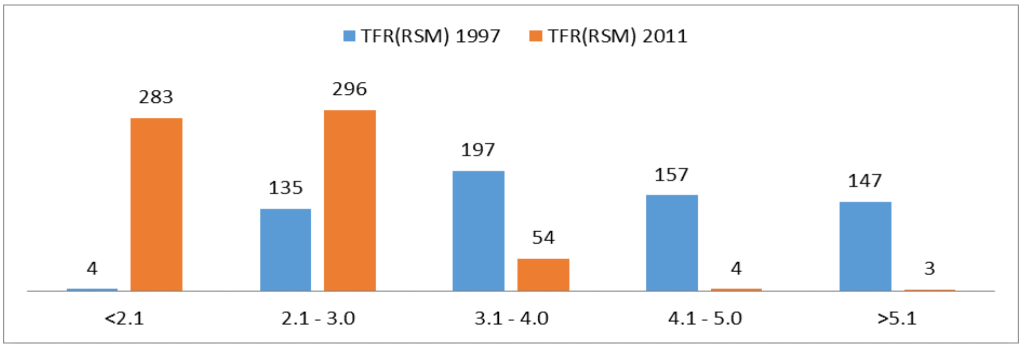


Figure 3.1. Distribution of districts in India by range of variation in TFR(RSM), 1997 and 2011.

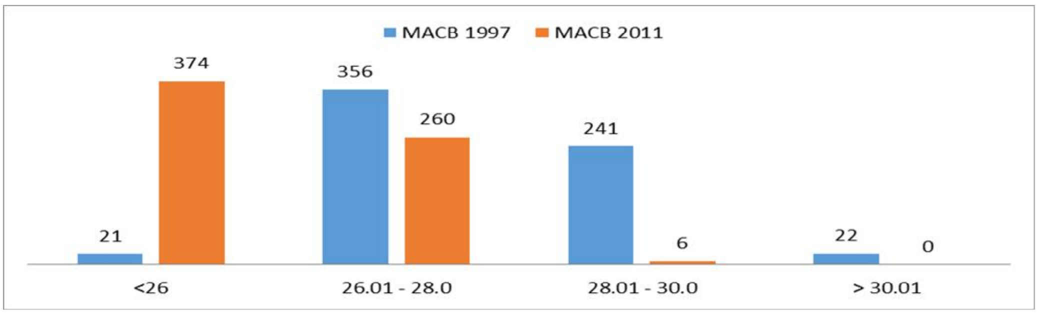


Figure 3.2. Distribution of districts in India by range of variation in MACB, 1997 and 2011.

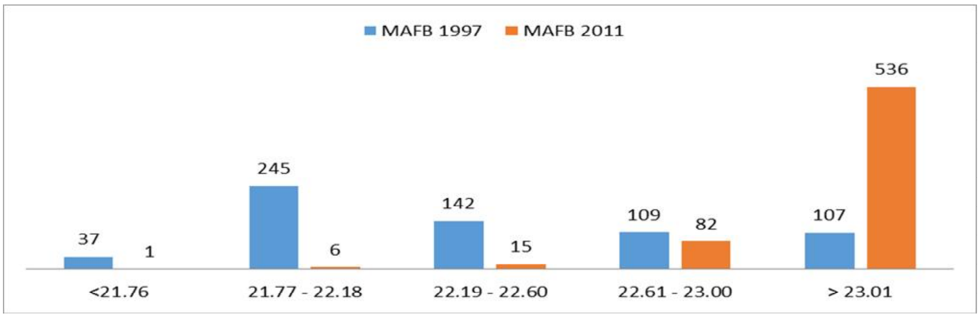


Figure 3.3. Distribution of districts in India by range of variation in MAFB, 1997 and 2011.

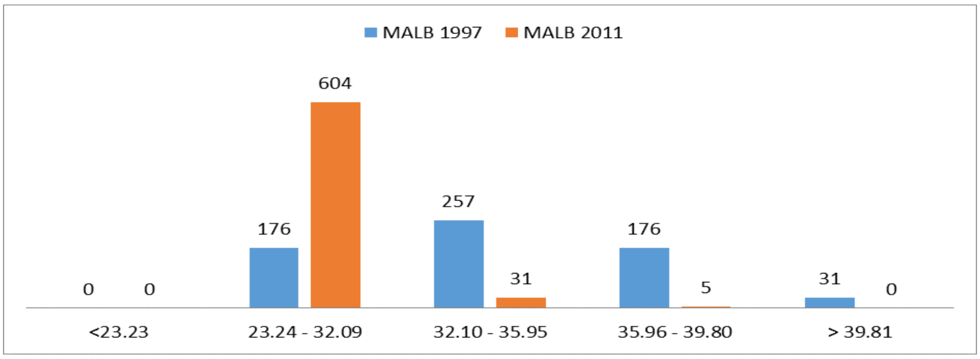


Fig. 3.4. Distribution of districts in India by range of variation in MALB, 1997 and 2011.

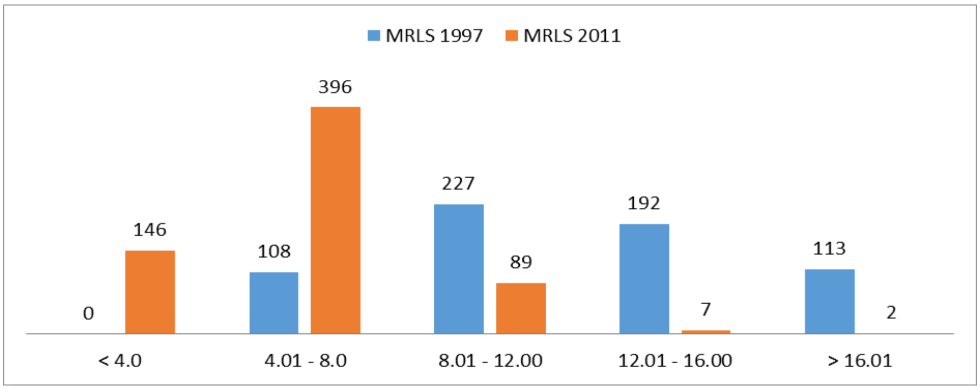


Fig. 3.5. Distribution of districts in India by range of variation in MRLS, 1997 and 2011.

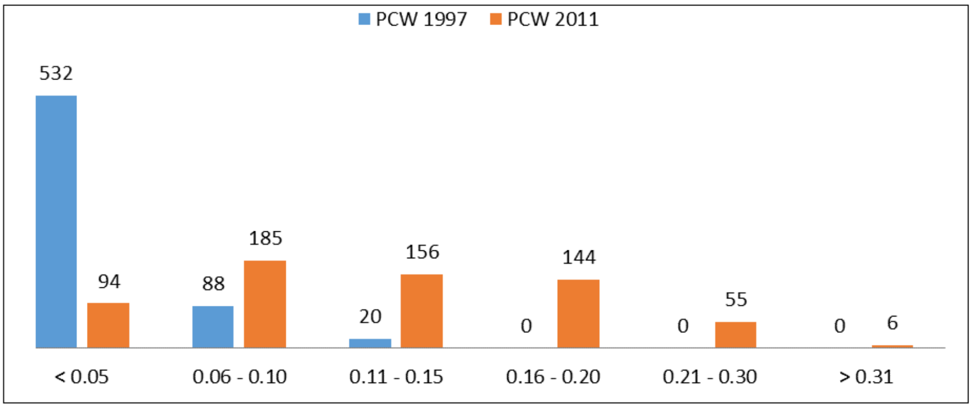
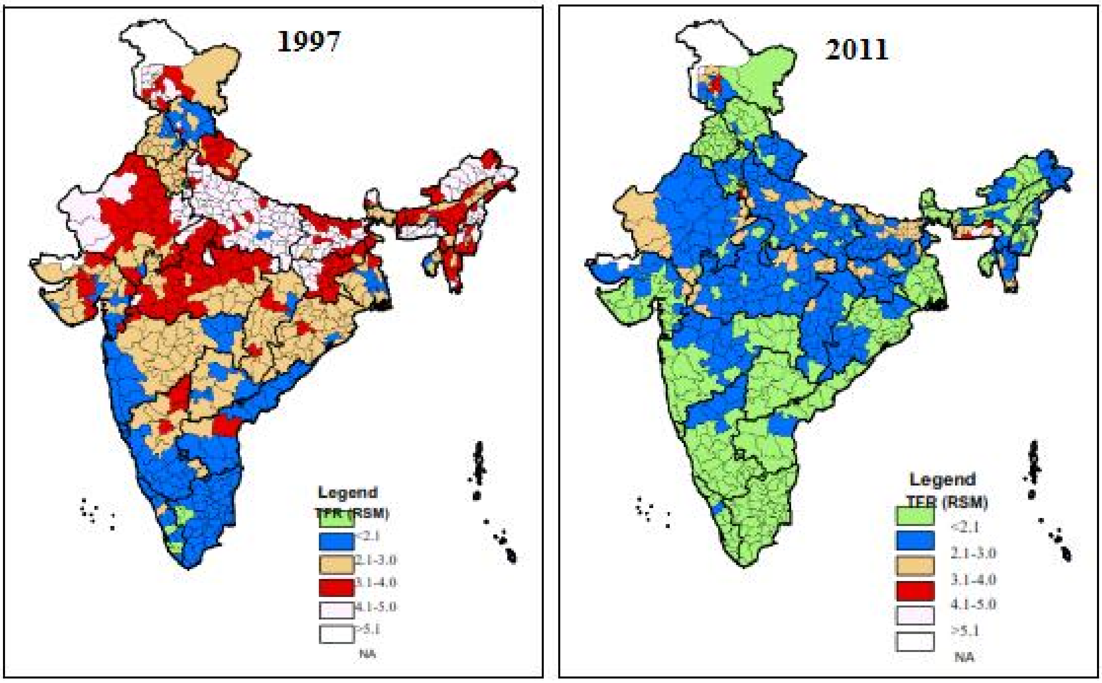
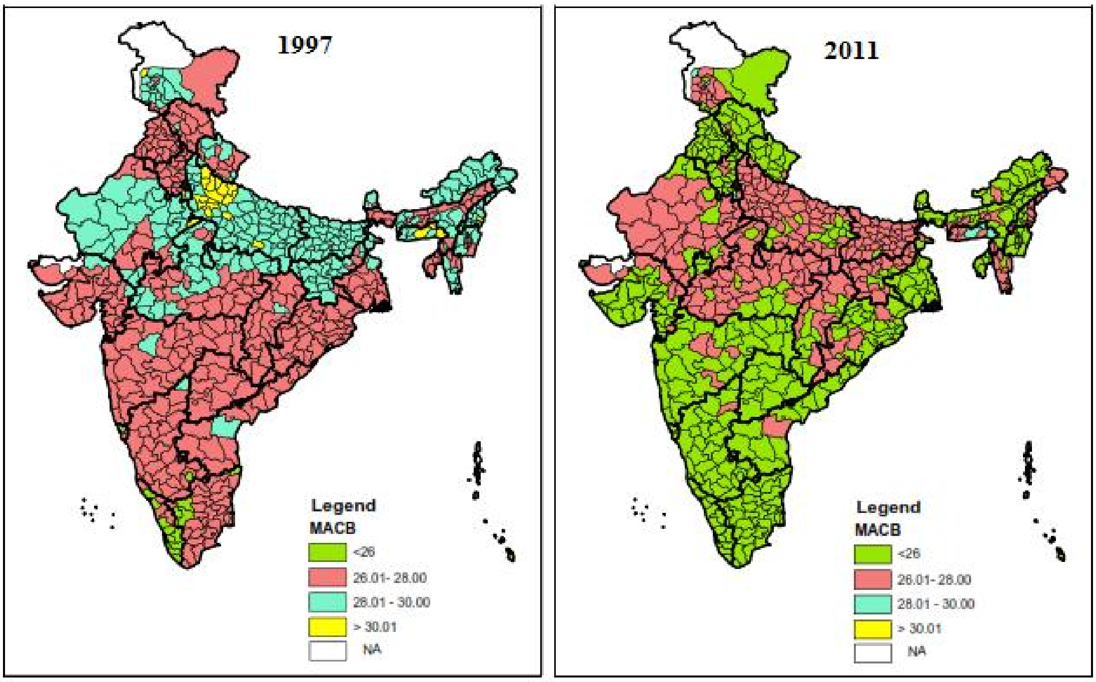


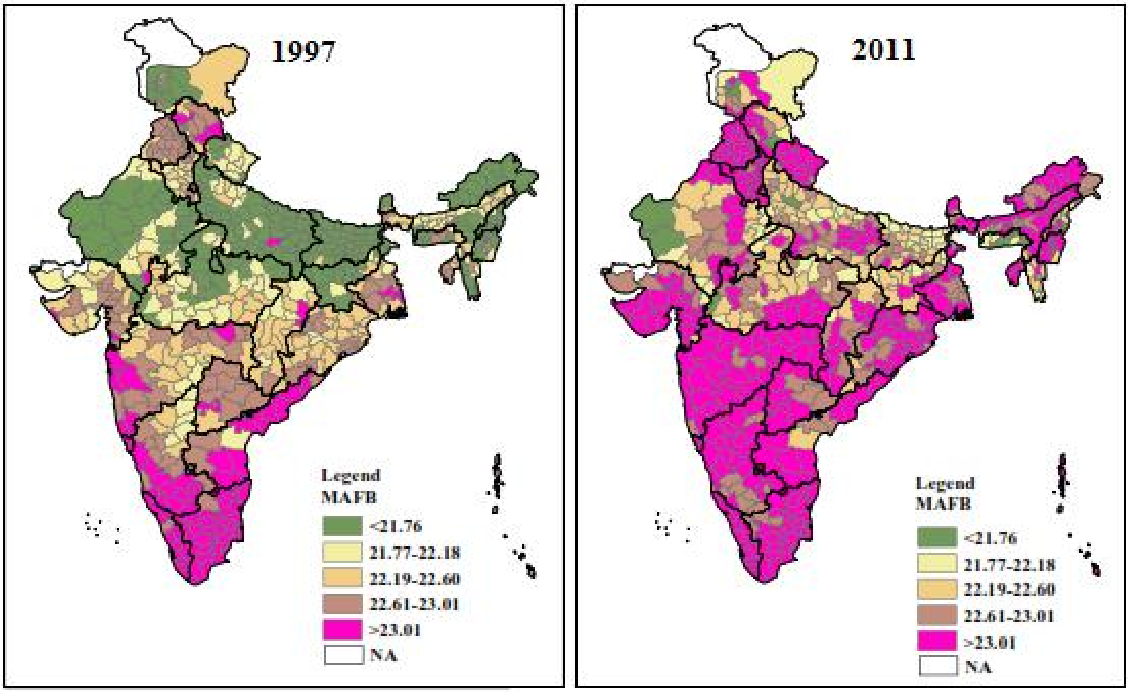
Figure. 3.6. Distribution of districts in India by range of variation in PCW, 1997 and 2011.



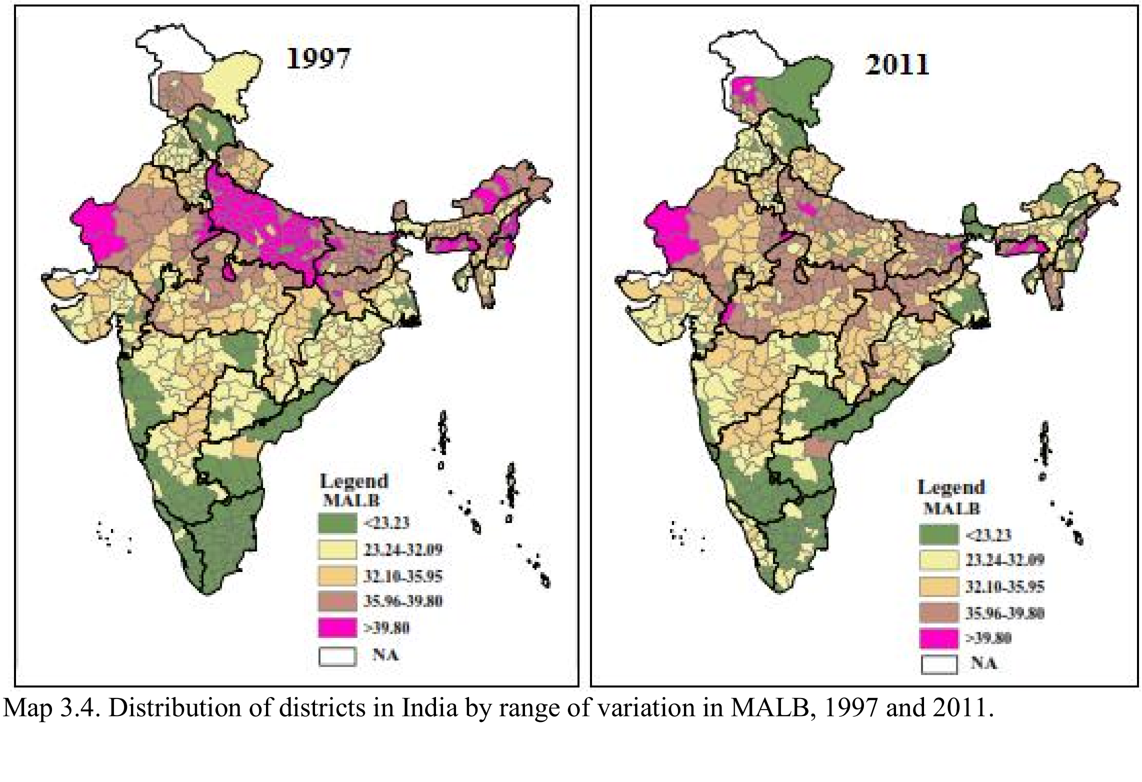
Map 3.1. Distribution of districts in India by range of variation in TFR (RSM), 1997 and 2011.



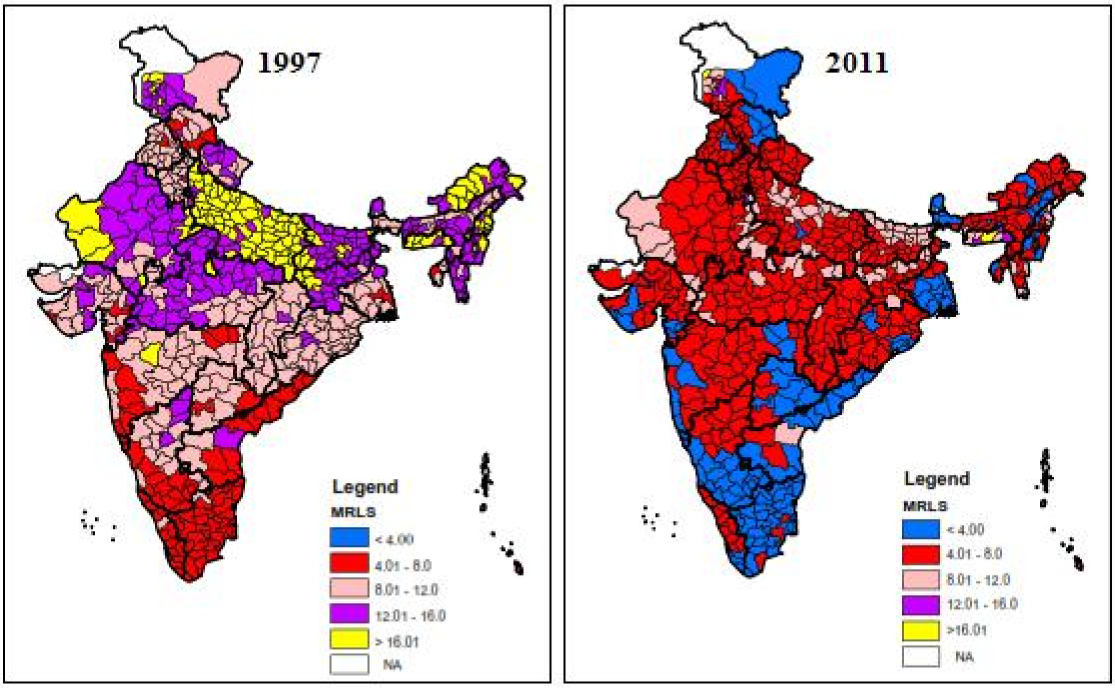
Map 3.2. Distribution of districts in India by range of variation in MACB, 1997 and 2011.



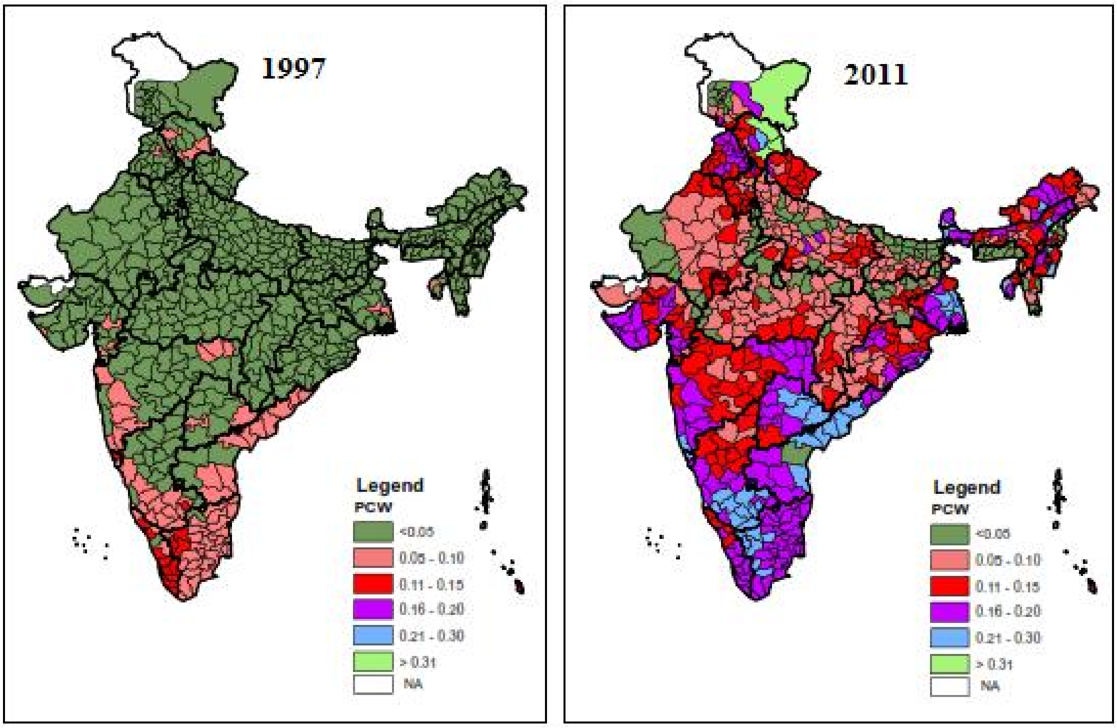
Map 3.3. Distribution of districts in India by range of variation in MAFB, 1997 and 2011.



Map 3.4. Distribution of districts in India by range of variation in MALB, 1997 and 2011.



Map 3.5. Distribution of districts in India by range of variation in MRLS, 1997 and 2011.



Map 3.6. Distribution of districts in India by range of variation in PCW, 1997 and 2011.

4. CONCLUSIONS

In conclusion, it may be stated that the childbearing indices thus derived here indirectly from the only information on TFR (RSM) and a set of regression models developed using state level data of India overtime, seem to be reasonable and supports the view that the fertiltiy transition is well in progress in India and its sub-units during the study period 1997 to 2011. From an observation of the six radar maps, six frequency distribution diagrams and India by district maps that shows variations in the various childbearing indices it is clear that, as expected, excepting for MAFB and PCW all other indices have shown a declining trend in their values over time from 1997 to 2011. It is true in case of India, its states and various districts. In casse of India, in general, all the childbearing indicators including MAFB and PCW considered here thus seem to be behaved as the fertility theory explained. District level estiamtes corroborate the findings found at all India and state level. The new methodology which is experimented here however seem to be providing meaningful results for India at the district level, may further be eperimented and further be tested for its validity in terms of its methodological/theoretical aspects.

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6. CONFLICT OF INTEREST

There are no conflicts of interest.

7. REFERENCE

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Appendix Table 1: TFR (RSM) and other Childbearing Indices derived from the regression models, 1997 & 2011, India and Major states

	TFR (RSM)	TFR (RSM)	MACB	MACB	MAFB	MAFB	MALB	MALB	MRLS	MRLS	PCW	PCW
	1997	2011	1997	2011	1997	2011	1997	2011	1997	2011	1997	2011
INDIA (IN)	*3.84*	*2.14*	*27.56*	*25.86*	*22.35*	*23.39*	*33.72*	*28.75*	*11.4*	*5.35*	*0.02*	*0.12*
Andhra Pradesh (AP)	2.85	1.62	26.57	25.31	23.03	23.38	30.91	26.95	7.88	3.57	0.06	0.2
Assam (AS)	4.02	2.13	27.74	25.85	22.23	23.4	34.22	28.73	11.98	5.33	0.02	0.12
Bihar (BR)	5.6	2.95	29.33	26.67	21.76	22.96	38.49	31.2	16.72	8.24	0	0.05
Chhattisgarh (CT)	3.69	2.43	27.41	26.15	22.44	23.27	33.32	29.67	10.88	6.39	0.02	0.09
Gujarat (GJ)	3.38	1.99	27.1	25.71	22.65	23.43	32.45	28.27	9.8	4.84	0.03	0.14
Haryana (HR)	3.8	2.25	27.52	25.97	22.37	23.36	33.61	29.09	11.24	5.73	0.02	0.11
Himachal Pradesh (HP)	2.91	1.77	26.63	25.47	22.98	23.42	31.09	27.49	8.11	4.07	0.05	0.17
Jammu & Kashmir (JK)	4.55	3.08	28.27	26.8	21.97	22.87	35.67	31.58	13.71	8.72	0.01	0.05
Jharkhand (JH)	4.54	2.58	28.26	26.3	21.97	23.19	35.63	30.12	13.66	6.93	0.01	0.08
Karnataka (KA)	2.96	1.74	26.68	25.44	22.95	23.42	31.24	27.38	8.29	3.97	0.05	0.18
Kerala (KL)	2.27	1.85	25.99	25.56	23.35	23.43	29.15	27.77	5.8	4.34	0.10	0.16
Madhya Pradesh (MP)	4.21	2.55	27.93	26.27	22.13	23.21	34.73	30.03	12.6	6.82	0.01	0.08
Maharashtra (MH)	3.06	1.89	26.78	25.6	22.88	23.43	31.54	27.91	8.67	4.48	0.05	0.15
Odisha (Orissa) (OR)	3.45	1.98	27.17	25.7	22.6	23.43	32.65	28.24	10.05	4.81	0.03	0.14
Punjab (PB)	3.21	1.83	26.93	25.54	22.77	23.43	31.96	27.73	9.18	4.29	0.04	0.16
Rajasthan (RJ)	4.66	2.65	28.39	26.37	21.92	23.15	35.97	30.31	14.05	7.16	0.01	0.07
Tamil Nadu (TN)	2.44	1.63	26.16	25.31	23.27	23.38	29.69	26.98	6.42	3.6	0.09	0.2
Uttar Pradesh(UP)	5.78	2.55	29.51	26.27	21.78	23.21	38.96	30.03	17.18	6.82	0	0.08
Uttarakhand (UT)	4.34	2.2	28.06	25.92	22.06	23.37	35.1	28.94	13.04	5.56	0.01	0.11
West Bengal (WB)	3.29	1.66	27.01	25.35	22.72	23.39	32.18	27.1	9.46	3.7	0.04	0.19
Minimum	*2.27*	*1.62*	*25.99*	*25.31*	*21.76*	*22.87*	*29.15*	*26.95*	*5.8*	*3.57*	*0*	*0.05*
Maximum	*5.78*	*3.08*	*29.51*	*26.8*	*23.35*	*23.43*	*38.96*	*31.58*	*17.18*	*8.72*	*0.1*	*0.2*
Range	*3.51*	*1.46*	*3.52*	*1.49*	*1.59*	*0.56*	*9.81*	*4.63*	*11.4*	*5.15*	*0.1*	*0.15*

Source: Estimated by the researchers.