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Title: Fertility Transition and Poverty Reduction in Districts of India

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Fertility Transition and Poverty Reduction in Districts of India

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Abstract

The aim of this paper is to examine the nature of relationship of fertility and poverty reduction in districts of India. Data from multiple sources; the census of India, 1991, 2001 and 2011, the District Level Household Survey 2004-05 and 2007-08 and the National sample Survey, 1993-94, 2004-05 and 2009-10 is used in the analyses. The district is the unit of analyses and data on demographic, social and economic dimensions of 640 districts are derived at three point of time. The Total Fertility Rate (TFR) is estimated from the population of under seven years of age using reverse survival method and the poverty estimates is derived from the consumption expenditure data using the official poverty line. The relationship of fertility transition and money metric poverty is examined using the descriptive statistics, ordinary least square and the fixed effect and random effect model.

Results indicates that fertility transition is a significant determinant of poverty reduction in districts of India. A 10% reduction in fertility leads to 7% reduction in poverty controlling for macro economic factors at state level (economic growth, state domestic product percapita and fiscal deficit). The other significant predictors of poverty reduction are use of modern method of contraception, female literacy, percentage of laborer households and the region. On the other hand, the relationship of poverty and TFR is becoming weak over time. While female literacy, hospital based delivery and sterilization are negative and significantly related with TFR, the level of poverty is not significantly related to fertility change. This demonstrate that fertility transition is a significant determinant of poverty reduction and hence the need to focus on small family norm and promotion of modern contraceptive in poverty eradication program of high fertility districts.

Fertility Transition and Poverty Reduction in Districts of India

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Introduction

Poverty reduction is a priority agenda, both nationally and globally. The global effort on poverty reduction continued over decades and gain momentum in Millennium Declaration, 2000. Eradication of poverty in all form; hunger, illiteracy and ill health is the central focus of millennium development goals and all member nations pledge to fight against multidimensionality nature of poverty. While economic growth, public policy and governance are necessary conditions in reducing poverty, the role of demographic factor in reduction of poverty and inequality cannot be negated. Understanding the nature of relationship of poverty and fertility reduction is essential to include fertility inhibiting measures in poverty eradication program of developing countries.

There is a considerable body of literature on poverty and fertility linkages, which is mainly drawn from cross-sectional data. These studies highlight the bi-directional and complex relationship of poverty and fertility at macro and micro levels. These writings are grouped into three "categories", namely, i) macro level (household) effects of fertility change on poverty, ii) micro level effects of poverty on fertility, and iii) micro level effects of fertility on poverty (Amin et al 2007). While macro level studies generally conclude that increases in absolute poverty are due to higher levels of fertility (Eastwood and Lipton 1999), micro level studies establish that poor households tend to have larger families and that their children have lower schooling and poor health (Desai 1995). Micro level studies also deal with the reverse causality, that is, the effect of fertility on economic well being. Studies have also explored contextual

factors such as family planning programmes, health services, social structure, institutional characteristics and the level of development in understanding the relationship between poverty and fertility (Diamond *et al* 1999). It is commonly argued that fertility and contraception are important factors for poverty reduction at the national and household levels (Merrick 2002). Studies from 25 Sub-Saharan Africa countries found weak association between fertility changes and economic status (Schoumaker 2004). Dreze and Murti (2001) found a negative but insignificant relationship between poverty and fertility in the districts of India. The role of space been incorporated to studies of fertility decline as an object of investigation rather than as neutral variable (Guilmoto and Rajan 2001; Schmertmann *et al* 2008).

Fertility transition in India is of global significance not only due to it size of population but also regional diversity in the level of socio-economic development. By 2012, 17 of the 29 states of India has reached the replacement level of fertility while the four larger states of India, namely, the states of Uttar Pradesh, Bihar, Madhya Pradesh and Rajasthan continued to have unacceptably higher fertility. Demographic research in last two decades have extensively focused on the determinants of fertility change in India at macro level and less at disaggregate level (district level). While the large scale demographic health surveys, such as the District Level Household Survey has bridged the data gap in reproductive and child health indicators, it does not provide the fertility and mortality estimates in districts of India owing to sample size constraints. With limited resources and emphasis on decentralized planning such estimates at district level are essential for effective program implementation.

On the other hand, the poverty estimates in India is derived by the Planning Commission , Govt of India from the consumption expenditure data collected by the National Sample Survey in its quinniquennal survey. These estimates are used for all practical purpose among planners, policy makers, academia and the international organisation. According to the latest estimates, the percentage of population living below poverty line in India has declined from 45.7% in 1993-94 to 29.9% in 2009-10 (Planning Commission 2012). Such estimates by Planning Commission are provided at national and state level by rural and urban classification. But, there is large variation in poverty level among the districts within the state and there s a greater demand to provide such estimates in districts of India. Also, there is a need to explore the estimates of poverty in districts of India because district is the central administrative unit in India. The aim of this paper is to examine the relationship of fertility transition and poverty reduction in districts of India. We have used the money metric poverty (derived from consumption expenditure data for two period of time) for all districts of India and the indirect estimates of TFR is derived for 640 districts using data on children under 7 years from national census. The estimates of poverty are correlated with levels and change in fertility estimates.

The paper has been conceptualized with the following rationale. First, the relationship of fertility and poverty is of interest as fertility transition in India is taking place in diverse setting. Empirical research in India has amply addressed the determinants of fertility change using unit or aggregate data at state level, there are limited number of studies that examine the fertility changes in districts of India. Second, though half of the states of India has achieved the reached the replacement level of fertility, it is uncertain when can India stabilize the population. The NRHM laid little emphasis to contraceptive use in poor performing states. Thus, identifying the district with slow reduction in fertility may be helpful for evidence based planning. Third, the

district level analysis would be helpful to capture the social dimension of fertility change (the social norm and diffusion effect) where as the household analysis would miss the effect of woman's behavior on fertility decision of other women (Dreze and Murthi 2002). Fourth, the district is the central administrative unit in India as many of the program are monitored at district levels. The managers, administrators and the planners often seek the monitoring indicators at district level for effective implementation of the program.

Data and Methods

Data is from multiple sources is used in the analyses. These include the Census of India, 1991, 2001 and 2011, the National Sample Surveys, 1993-94, 2004 and 2009-10 and the District Level Household Surveys (DLHS 2003-04, 2007-08). Estimates are derived at the district level and district is the unit of analyses. As of 2011, there are 29 states, 6 union territories, 84 NSS regions and 640 districts in India. We have used the estimated TFR from our earlier work that used the population in the 0-6 age group of three consecutive census (Mohanty and Rajbhar 2013). The estimated U5MR for 1991 and 2001 of each district was used from the Census of India publication (RGI 1997; 2009). For 2011, the U5MR for 274 districts were taken from the estimates of the Annual Health Survey 2011 (RGI 2011_b). For the remaining districts we assume that the decline in mortality during 2001 and 2011 was similar to the decline observed at the state level. Data on literacy rate, urbanization, caste composition and under-five mortality was compiled from the Census of India publications. Data from NSS on consumption expenditure is used to estimate poverty in regions and district of India. The state specific poverty line as outlined by the Planning Commission using Tendulkar methodology is used (Planning Commission 2012). The NSS sampling frame from 2004 onwards has been designed to derive

the district estimates (Chowdhury Navdita 2010). However, we have estimated the poverty in districts of India for 2004 and 2009-10. Districts those had less than 90 households were replaced by regional estimates of poverty. In 2009-10, there were 48 districts with sample size less than 90 and in 2004 there were.. districts with sample size less than 90 which are replaced by their regional estimates. For 1993-94, we assume that the decline in poverty in districts is similar to that of regions it belongs and hence derive estimates from 2009-10 estimates. In all the three period we have fixed the upper and lower limit of poverty at 10% and 90% respectively. We have used the percentage of ever married women using any modern method of contraception and the percentage of girls marrying below 18 years from the District Level Household Survey 3 (IIPS 2010). The state level estimates of State Domestic Product Percapita (SDPP) from Central Statistical Organisation Web Site and these were converted to 2004 base prices. The average growth rate for each of the state was computed. The fiscal deficit as percentage of GDP is computed from the Reserve Bank of India (RBI). During 1990-2011, the number of districts has increased from 466 to 640. In cases district estimates for new districts are not available, we have kept the estimates of new districts same as parent district or average in case district crated from two or more districts.

We have used two dependent variables; reduction in poverty during 1993-2010 and the total fertility rate as the dependent variable. The independent variables used are a set of demographic, developmental, population composition, time and region. The fertility transition is measured with the help of the percentage of decline in total fertility rate (TFR) and poverty reduction is measured by percentage reduction in head count ratio. The poverty estimates for 1993-94 is derived using $P_{1993\text{-}94} = P_{2009\text{-}10} / 1 - D_{1993\text{-}2010}$

where $P_{1993-94}$ and $P_{2009-10}$ refers to percentage of population living below poverty line in 1993-93 and 2009-10 respectively.

$D_{1993-2010}$ is the percentage decline in poverty in regions of India during 1993-2010. The ordinary least square is used to examine the relationship of poverty and fertility.

Besides, the fixed effect model (within district) and random effect (between district) model on the pooled data are used to examine the district specific effect on poverty and fertility.

The decline in percentage of population below poverty line is regressed against a set of predictor variables to understand the role of each factors in explaining variation in poverty. We have used three models; in model 1the decline in poverty is regressed against decline in TFR while in model 2 we have included the other socio-economic and demographic variable. In model 3, the regional dummies are included.

The regression model that is estimated is

$PD_{POV93-10} = a+b1.PD_{TFR93-10}+Xi, 2009-10+u$

where $PD_{POV93-10}$ is the percentage decline in poverty during 1993-2010

$PD_{TFR93-10}$ is the percentage decline in fertility during 1993-2010

Xi is the set of explanatory variables

The state level factors such as growth rate of SDPP, the current level of SDPP and fiscal deficit as percentage of SDPP is controlled.

In the second set of regression model, the TFR is the dependent variable and is regressed against the explanatory variables for each time period. We have also used the fixed and random effect model to understand the effect of district in fertility decline. The fixed effect model allows to

study the relationship between changing condition and poverty and the slope coefficient of fixed effect model explains the change in TFR holding district specific effect constant.

The panel regression equation used in the form of $TFR_{dt} = \alpha_d + \beta X_{dt} + Y_t + e_{dt}$

where TFR_{dt} $_t$otal fertility rate in district at time
X_{dt} is the vector of explanatory variables

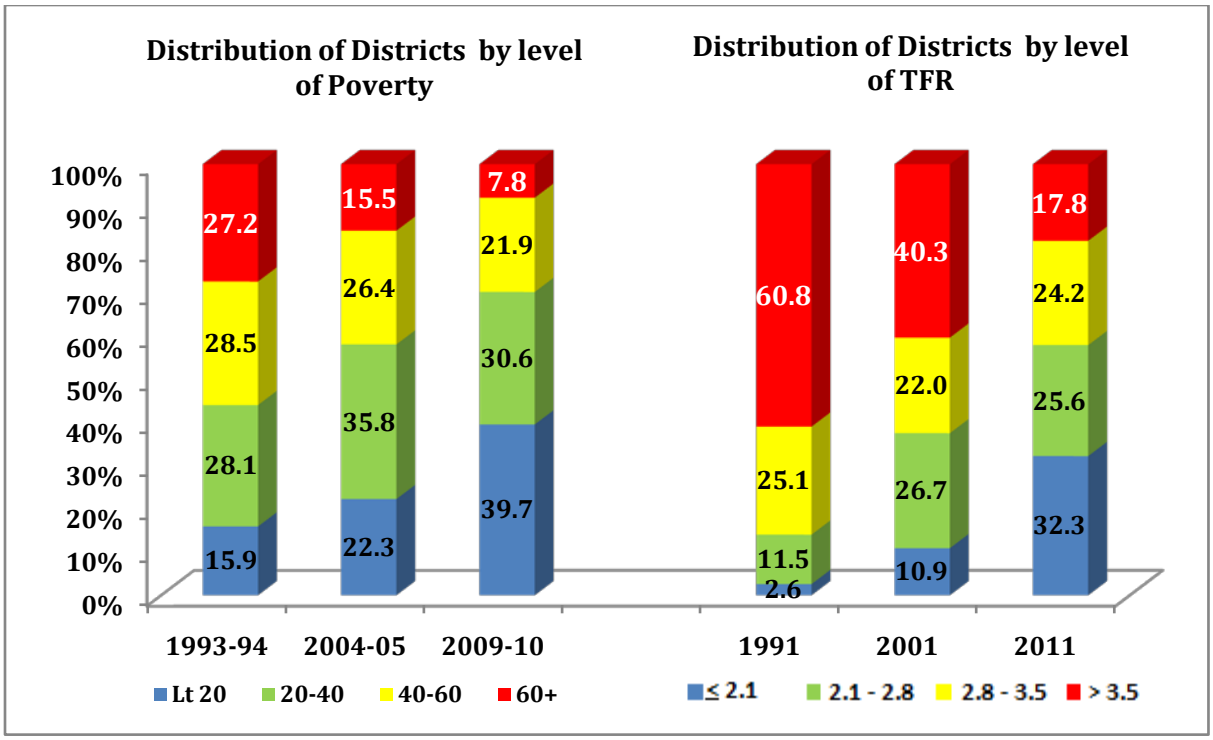
Y_t is $_a$ time dummy variable and

e_{dt} is the error term

The estimated TFR and the percentage of population living below poverty line are presented using Arc Map 10.

Results

Fig 1 presents the percent distribution of districts by level of poverty and fertility in a span of 20 years. By 1993, about 16% districts had poverty level less than 20% and it has increased to 40% by 2009-10. Similarly, about 27% districts had poverty level of more than 60% and it has declined to 16% by 2009-10. With respect to fertility while 3% district had below replacement level of fertility in 1991, it has increased to 32% by 2011. Similarly, while 61% districts had TFR of above 3.5 in 1991, it has declined to 18% in 2011. From this graph it is clear that most of the districts in India are experiencing fertility transition and poverty reduction in last two decade.



To understand the pattern of fertility transition, Bhat (1997) had linked the TFR in the districts of India to their variance; low variance and normal curve in the early stage (Stage I), increased variance and negative skewed during the transitional period (Stage II), large variance and normal curve (Stage III), declining variance and positively skewed thereafter (Stage IV) and a small variance and a normal curve at the time of completion of transition (Stage V). The variance of TFR in districts of India has increased from 0.87 in 1991 to 0.91 in 2001 and declined to 0. 71 by 2011. The distribution of TFR is negatively skewed over time confirming the fertility transition in districts of India. However, the pattern varies largely in states of India. In case of high fertility states of Uttar Pradesh, the variance in TFR had increased from 0.10 in 1991 to 0.14 in 2001 and 0.17 in 2011 indicating that the state is in second stage of demographic transition. In case of Bihar, the variance in TFR has increased from 0.05 in 1991 to 0.09 in 2001 and 0.15 in. In case of Maharashtra, the variance in TFR had declined from a high level of 0.24 in 1991 to 0.11 in 2011 indicating the transition in districts of Maharashtra. On the other hand, the variance of TFR

in Tamil Nadu (a low fertility state) declined from 0.068 in 1991 to 0.025 and 0.018 by 2011. The distribution of TFR indicates the varying stage of fertility transition in districts of India. The high fertility in Indian districts (TFR of more than 3.5) is now confined to a few states; Bihar, Uttar Pradesh, Jharkhand and Madhya Pradesh. The pattern of fertility transition in the states of Bihar, Uttar Pradesh and Tamil Nadu is shown in fig 2 (a)-2 (b). In case of Tamil Nadu, the distribution variance has reduced and follows a normal curve indicating the transition has completed. In case of Bihar and Uttar Pradesh, the variance is increasing and

Fig 2 (a): Distribution of districts by level of TFR and time in India

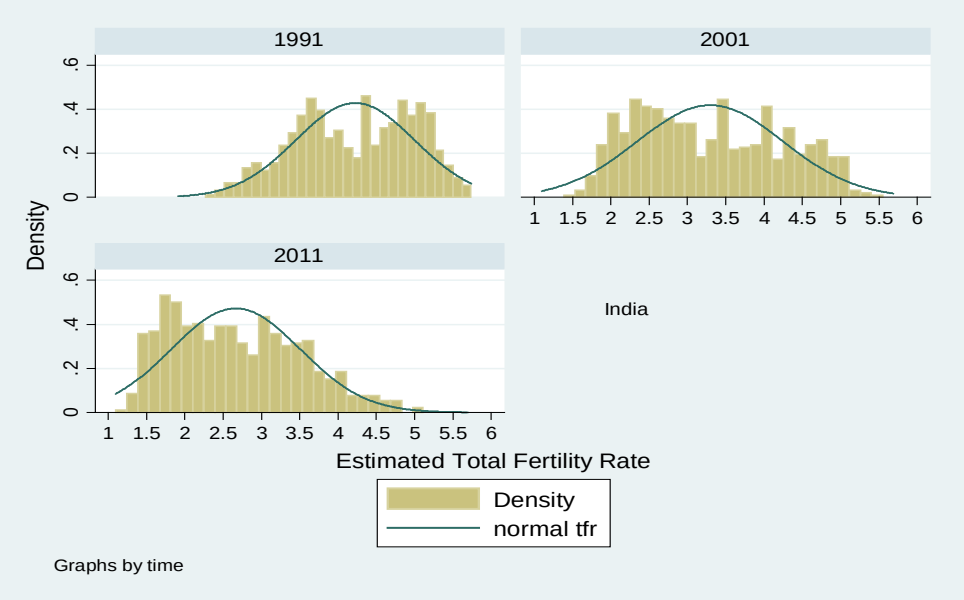


Fig 2 (b): Distribution of districts by level of TFR and time in Tamil Nadu

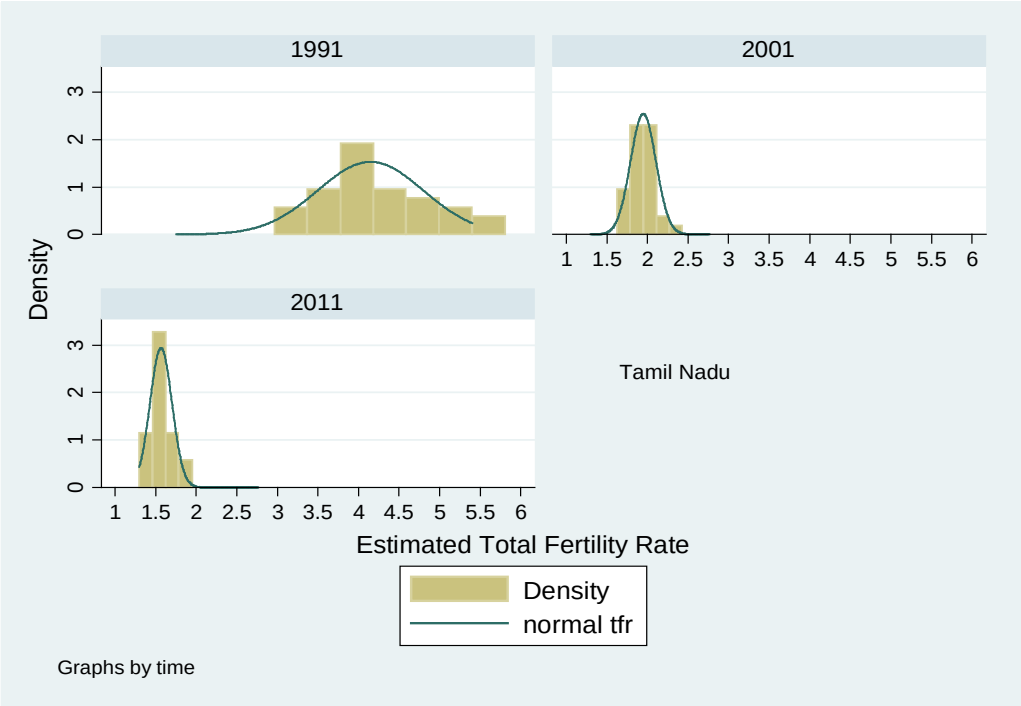


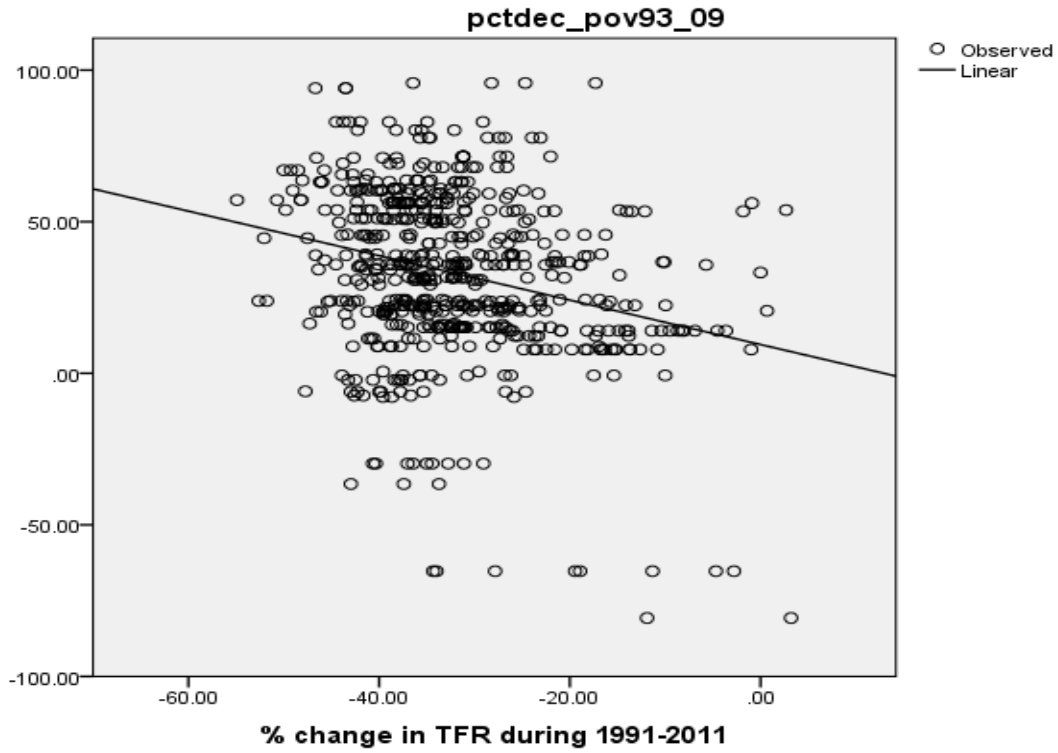
Fig 3(a)-3(c) presents the distribution of poverty across districts of India. While the mean value of poverty has declined from 44.8 in 1993-94, 37.5 in 2004 and 30.5 by 2009-10, the coefficient of variation has increased from 0.48 to 0.61 during this period. This indicate that the variation in poverty level has increased over time. The districts those had higher level of poverty in 2009-10 are Malkanagiri of Odisha followed by Sidhi in Madhya Pradesh, Koraput in Odisha, Singrauli in Madhya Pradesh and Halikandi in Assam. Many of these districts did not experience significant decline in fertility level in last two decades.

Reduction in Poverty and Fertility in Districts of India

We also plotted the districts by reduction in poverty and fertility (Fig 4). We found that in general those districts reduced fertility faster also reduced poverty significantly. On tabulating the districts by percentage decline in poverty and fertility we confirm that those districts reduced fertility slower also reduced poverty slower (Table 1). Among all districts that had recorded

more than 40% decline in TFR, 29% reduced poverty by 60% compared to only 1% among districts that reduced poverty by less than 20%.

Fig 4: Scatter Plot of parentage decline in poverty and percentage decline in TFR in districts of India



To understand the relationship of poverty and fertility in districts of India we have attempted three regression model with reduction of poverty as dependent variable (Table 2). In model 1, percentage decline in poverty is the dependent variable while in model 2 a set of socio-economic and other demographic variables are added. In model 3, the region is added to the list of variables in model 2. We found that reduction in fertility is a significant predictor of poverty. A 10% decline in poverty leads to 7% decline in TFR. The single variable alone explains 6% variation in the model. On adding the set of socio-economic variables the coefficient reduced to 0.199 and the model explains 39% of the variation in reduction of poverty. The other significant predictor of poverty reduction are use of modern method of contraception, early marriage of girls

and the under-five mortality. The coefficient of female literacy is larger and significant predictor of poverty reduction. In model three, the coefficient of fertility decline is 0.30 and statistically significant. Most of the variables except schedule caste and Muslim population are significant predictor of poverty reduction in districts of India.

Determinants of TFR in districts of India

To understand the determinants of TFR in the district of India, we have run a set of regression models with TFR as dependent variable for 1991, 2001, 2011 and by pooling data for three period of time (Table 3). The selection of the independent variables is guided by literature and the availability of data in particular time. In 1991, the percentage of population living below poverty line was not a significant predictor of TFR. The significant predictors are female literacy, urbanization, scheduled tribe population and region. In 2001 we have added percentage of women using modern method of contraception, percentage of girls marrying below age 18, percentage of institutional delivery and the MPCE along with the variables in 1991. We found poverty is not a significant predictor of TFR. Also the institutional delivery and the south dummy is not significant in the model. For 2011, we run the same regression model with similar variables. Though the coefficient of poverty is of similar magnitude as in 2001, it was significant at 10% level. The explanatory power of these variables ranges from 81-85%.

We have also regressed the TFR against the predictor of 2001 and 2011 by pooling the data for 2001-2011. In the pooled data we estimated the fixed effect and the random effect model to understand the district specific effect (Table 3, col5-6). In the random effect model of 1991-2011, the gender differential in mortality, TFR, female literacy, percent urban and region were

statistically significant. In the random effect model the contraceptive use, percentage of girls marrying below age 18, under-five mortality rate, percent urban, percentage of ST and Muslim population and all regions except southern region were significant predictor of TFR. The coefficient are in expected direction. However, percentage of population living below poverty line is not a significant predictor of TFR. In the fixed effect model also, poverty is not a significant predictor of TFR. This indicates that the cross sectional results also holds true in the fixed effect model and relationship of poverty and fertility is weak. When the district effect is fixed, contraceptive use, percentage of girls marrying below age 18, under-five mortality, female literacy and percent urban are significant predictor of TFR.

Discussion and Conclusion

Fertility transition and poverty reduction is concomitant in states of India. Fertility transition is taking place across all socio-economic groups and space (Bhat Arokiasamy Mohanty and Ram). While poverty reduction are largely attributed to the economic growth, redistributive measures and social welfare program, the role of demographic factors in poverty reduction are largely neglected. On the other hand, the fertility transition are largely attributed to two of the proximate determinants; namely marriage and contraception. Though research studies have established the economic and societal gain of small family, there are limited studies on poverty and fertility relationship in districts of India. The district as the unit of analyses is at center of focus not only due to decentralized planning but also due to not only household level analyses does not capture the effect of diffusion in reduction of fertility, the district as a unit would help to do so. Using data from multiple sources this paper examines the relationship of population growth and

poverty reduction in districts of India. It examined the relationship of reduction in fertility and poverty in a multivariate framework.

Our results indicate that fertility transition significantly contribute to the reduction in poverty controlling for the growth rate of state domestic product, the fiscal deficit as percentage of state domestic product and foreign direct investment. Districts that had experienced higher fertility reduction also reduced poverty faster. These results were confirmed in both bi-variate and multivariate analyses. Also, the use of modern method of contraception, percentage of girls marrying below 18 years and under-five mortality are other significant predictor of decline in poverty. We also found the role of space in reduction of poverty as region is significant predictors in the model. On the other hand, we found that the relationship of poverty and fertility is weak over time. From the cross sectional regression at three point of time and from the pooled data we found that poverty is not a significant determinant of TFR. This supports the micro-level studies that poverty is not a barrier to fertility decline in districts of India. However, reduction of fertility do help to reduce poverty to a large extent.

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Table 1 :Does reduction in fertility lead to decline in poverty in districts of India? Percent distribution of districts by change in fertility and poverty level in districts of India, 1991-2011

Percentage Decline in TFR	Percentage decline in poverty					
	Less than 20	20-40	40-60	60+	Total Percent	Number of districts
Less than 20	58.33	25.0	15.28	1.39	100	72
20-30	28.13	40.63	19.53	11.72	100	128
30-40	25.08	33.90	24.75	16.27	100	295
40+	18.70	30.08	21.95	29.27	100	123
Total Percent	28.32	33.50	22.01	16.18	100	618

Table 2 : Result of OLS with reduction in poverty as dependent variable 1991-2011

	Model 1 (Only change in poverty as expl variable)	Model 2 (Change in poverty along with other socio-economic and demographic variables)	Model 3 (Change in poverty along with socio-economic, demographic and regional dummies)
Demographic Variables			
Reduction in TFR	0.708*** (0.11)	0.199* (0.12)	0.300*** (0.116)
Contraceptive use (modern method)		0.213** (0.085)	0.180** (0.097)
Marriage below age 18		-0.242*** (0.087)	-0.239*** (0.082)
Under five mortality rate		-0.089* (0.048)	-0.007 (0.049)
Developmental Variables			
Female Literacy		-0.424*** (0.163)	-0.321** (0.160)
%Urbanization		-0.528 (0.356)	-0.361 (0.33)
MPCE		0.016*** (0.003)	0.020*** (0.003)
Caste and Religion			
Percentage Scheduled caste		-0.167 (0.156)	-0.113 (0.176)
Percentage Scheduled tribe		-0.299*** (0.058)	-0.228*** (0.058)
Percentage Muslims		-0.008 (0.098)	-0.463 (0.092)
District belongs to EAG states		13.16** (2.58)	-5.55 (4.32)
Regional Dummies			
South			45.2*** (5.24)
East			25.71*** (4.58)
West			28.58*** (4.98)
North			16.17*** (4.56)
UP-Bihar			13.88*** (3.93)
Northeastern states			24.60*** (6.2)
Interaction of female literacy and urbanization\on		0.002 (0.005)	-0.001 (0.004)
Constant	10.14	34.42*** (13.82)	21.22 (14.3)
N	607	607	607
Adjusted R^2	6.03		40.28
F -value	40.56		22.03

OLS= Ordinary least square GLS= Generalized least square RE= Random effect FE= Fixed effect * p<.1 * * p<.05, ***p< .001 t-ratio in parentheses. All the model are controlled for state level SDPP, growth rate of SDPP and fiscal deficit as percentage of SDPP

Table 3 : Result of OLS with TFR as dependent variable

	1991: OLS	2001:OLS	2011:OLS	Panel 2001-11	
				GLS-RE	OLS-FE
Constant	2.855*** (0.13)	2.548*** (0.22)	3.240*** (0.23)	2.660*** (0.126)	3.40*** (0.122)
Percentage of population living below poverty line	-0.0004 (0.001)	-0.002 (0.002)	-0.002* (0.001)	0.00001 (0.0007)	-0.0002 (0.0008)
Demographic Variables					
Contraceptive use (modern method)		-0.001 (0.001)	-0.008*** (0.005)	-0.0026*** (0.0007)	-0.002*** (0.0007)
Marriage below age 18		0.0004 (0.001)	0.010*** (0.001)	-0.001** (0.0005)	-0.003*** (0.001)
Under five mortality rate	0.006*** (0.001)	0.010*** (0.001)	0.005*** (0.0008)	0.0069*** (0.0005)	0.004*** (0.0007)
Developmental Variables					
Institutional Delivery		0.0008 (0.001)	0.000 (0.001)	0.0013*** (0.0005)	0.001** (0.0005)
Female Literacy	-0.016*** (0.002)	-0.011*** (0.002)	-0.017*** (0.003)	-0.010*** (0.001)	-0.005*** (0.001)
%Urbanization	0.007** (0.003)	-0.012*** (0.003)	-0.023*** (0.005)	-0.013*** (0.002)	-0.009*** (0.003)
MPCE		-0.0004*** (0.0001)	-0.0001* (0.0001)	-0.0002*** (0.00004)	-0.0001 (0.00005)
Caste and Religion					
Percentage Scheduled caste	-0.004 (0.003)	-0.003 (0.003)	-0.007*** (0.002)	-0.005 (0.003)	
Percentage Scheduled tribe	0.005*** (0.001)	0.004*** (0.001)	0.005*** (0.001)	0.005*** (0.001)	
Percentage Muslims	0.012*** (0.002)	0.004*** (0.001)	0.006*** (0.001)	0.007*** (0.011)	
Regional Dummies					
South East West North UP-Bihar Northeastern states	0.176** (0.07) 0.437*** (0.06) 0.745*** (0.06) 0.918*** (0.07) 1.518*** (0.05) 1.033*** (0.07)	-0.019 (0.085) 0.481*** (0.073) 0.711*** (0.066) 0.684*** (0.086) 1.566*** (0.066) 0.466*** (0.084)	-0.021 (0.079) 0.437*** (0.066) 0.649*** (0.063) 0.667*** (0.077) 1.115*** (0.083) 0.499*** (0.087)	0.112 (0.074) 0.458*** (0.066) 0.723*** (0.057) 0.811*** (0.071) 1.545*** (0.058) 0.520*** (0.072)	
Interaction of female literacy and urbanization\on	-0.0001 (0.00005)	0.0002*** (0.0001)	0.0003*** (0.00007)	0.0001*** (0.00003)	0.0001** (0.0001)
Time Dummy 2001 2011				 -0.248*** (0.028)	 -0.437*** (0.039)
F p-value	251.97	133.37	150.99		
Pseudo- R^2	85.40	85.40	81.67		
GLS vs FE, P value					

OLS= Ordinary least square GLS= Generalized least square RE= Random effect FE= Fixed effect * * p<.05, ***p< .001 t-ratio in parentheses

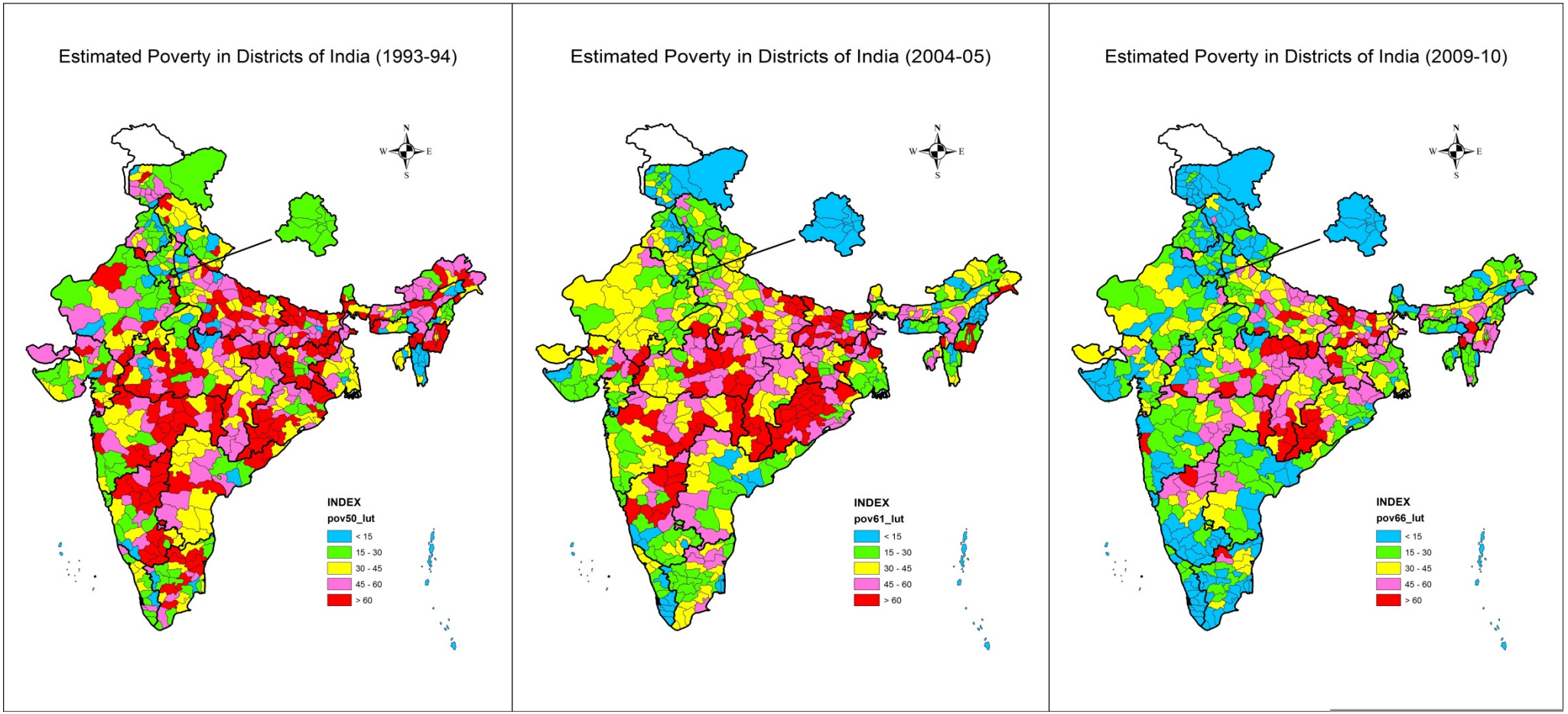

Fig 3(a) % of population living below Poverty line in districts of India, 1993-94 Fig 3(b) % of population living below Poverty line in districts of India, 2004, Fig 3(c) % of population living below Poverty line in districts of India, 2009-10