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# Does Spending on Human Capital Reduce Fertility and Poverty in India? A Panel Data Study

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Using panel data from 16 major states in India over 1972-73 to 2009-10, this paper examines the effect of human capital investment along with key socio-economic variables on fertility and poverty. The dynamic panel results confirm that the current poverty and fertility situation is well explained by the past periods poverty and fertility respectively. There exists a strong and significant impact of human capital investment on reduction of fertility and poverty; the joint dependence between poverty and fertility is empirically verified in our paper. Our findings do not support the inclusivity in respect of social development parameters except female literacy rate. It is observed that the inequality of human capital investment, healthcare and education spending across the major states over time is increasing. Unequal distribution and inadequate social sector spending generates differential decline of fertility and poverty in Indian states. Our development policy should be designed in such a way that can address the two vital issues (poverty and fertility) simultaneously for getting a desirable development outcome. This is because of endogeneity between poverty and fertility. This finding is expected to have some policy relevance in the context of future demographic dividend, inclusive growth, poverty reduction, and fertility regulation.

*Keywords:* human capital investment, poverty, fertility, social sector spending

India accounts for about 17.5% share of the global population but it is quite alarming to note that 36% of world's poor people live in the country. Among developing countries, India contributes the largest sum of births per year (about 27 million) in the world and alone accounts for 20% of global maternal deaths (Mavalankar, Vora., & Prakasamma, M. 2008). Although India did experience a decline of total fertility rate (TFR) from 6.0 in 1951 to 2.6 in 2009 and infant mortality rate (IMR) from 146 in 1951 to 50 in 2009, its global disease burden is still disproportionately high. Moreover, the incidence of poverty accompanied by higher fertility and mortality are not uniformly distributed over time among India's different states.

Against the backdrop of its high gross domestic product (GDP), the poverty rate in India has declined from 54.9% in 1972-73 to 29.8% in 2009-10. In the wake of structural adjustment programme in 1991, Indian policy makers initiated a process of wide ranging economic reforms to shift towards a more market friendly trade and industrial policy regime. The economic reform process has been steady but gradual because of a need for wide consultation and broad consensus necessary in a democratic society. The process of consultation and debate has contributed to non-reversal of policies even under different political parties that have formed the government after the reforms. Whether and to what extent India has achieved the stated objective of inclusive growth and faster poverty removal during the post-reform period has been a matter of intense debate. With such developments, India needs to be taken for an interesting case study to examine the emerging issues in social sector development, poverty reduction, and fertility control at the state level.

India is going to enjoy the benefit of demographic dividend roughly after 2025 (Population Reference Bureau, 2007). Achievement of this demographic gift requires declining fertility of the nation in favor of the share of working age population (Bloom & Williamson, 1998). However, having only the absolute number of the working age cohort cannot ensure to generate sufficient employment and income if the quality of the future human resource remains poor. Recent employment figures of India also suggest that absorption of Indian youth is not as high as one would expect due to poor employability of the work force, which is severely affected by the poor health and educational status of the working population (Chandrasekhar, Ghosh & Roychowdhury, 2006). Quality of the working population can be improved through effective human capital formation, which is possible through investment in social sector.

On the other hand, poverty in India is highly associated with fertility (Schoumaker, 2004). Children from the large family with inadequate income attain less schooling and work as child labour, which also sabotages the process of effective human capital formation and hampers the economic growth (Basu & Van, 1998). In this regard, investment in human capital is important to strengthen the capability of the population, which results in the reduction of poverty and fertility (Sen, 1997, 1999). But in India, overall scenario is quite different and rather alarming. India spends a very small proportion of its gross national product on health and education expenditure. Many similarly placed countries whose per capita incomes are well below India's average, spend higher in social sector development compared to India. In 1960-61, the education and healthcare expenditures, as a percentage of GDP, were 1.69 and 0.37 respectively; in 20010-11, public expenditure on education is a little over 3% of GDP but the total investment on public health remains dismally low, around 1% of GDP. In a country like India where a considerable share of population depends largely on public provision of health and education, public investment is not only crucial but also expected to be high in this respect. However, in reality, the situation is very poor. According to World Health Report (2005), per capita health expenditure in India (Rs. 96) is much lower than that of other countries like China and US (Rs. 261 for China and Rs. 5274 for US). In fact, share of healthcare and education expenditure in total social sector spending by all states fell from 16% to 11.7% and from 52.2% to 45.8% respectively over the 16 years from 1990-91 to 2006-07 (Reserve Bank of India, 2007-08).

## REVIEW OF LITERATURE

Economic development of any country necessitates economic resources and human capital.[1] Theories of endogenous growth developed by Romer (1986) and Lucas (1988) stated that apart from physical capital and labor, human capital is another important input for sustained output growth. The importance of social sector spending in accelerating the per capita growth of output is well established.[2] Poverty reduction, along with population stabilization, requires economic development which, when accompanied by sound macroeconomic management and good governance, results in sustainable and socially inclusive development (Ali & Pernia, 2003). A country, without a labor force having minimum level of health stock and educational attainment is incapable of maintaining a state of continuous economic growth (Van Zon, A. & Muysken, 2005). Human capital exerts impacts on productivity, employment, income generation, fertility, and poverty reduction. Modern human capital theory suggests that individuals and society derive economic benefits from investment in people. Education has consistently been emerged as the prime human capital but Becker (1993) and Schultz (1997) have argued that health and nutritional expenditure are also part of human capital investment. This is because education is perceived to contribute to health and nutritional improvements. Education, health, nutrition, water and sanitation complement each other, with investments in any one contributing to better outcomes in the others (United Nations, 2003). Given the fiscal constraints of developing country like India, investment in social sector development, mainly health and education, may be contemporaneous substitutes or complements.

Social sector spending is distinct from other types of public spending like investment in infrastructure like roads, electricity connection, irrigation facility, transport, and so forth. Returns from social sector spending is not instantaneous, it affects the growth of output in the long run and gives increasing (or at least constant) returns to scale through labor productivity. Numerous studies have been conducted both theoretically and empirically in relation to welfare gains due to public spending (Fan, Zhang, & Rao, 2004; Fan, Jitsuchon, & Methakunnavut, 2004; Jha, Biswal, & Biswal, 2001; Shariff, Ghosh, & Mondal, 2002; Gomanee, Morrissey, Mosley, & Verschoor, 2003; Mosley, Hudson, & Verschoor, 2004; Gupta & Mitra, 2004; Wilhelm & Fiestas, 2005; Paternostro, Rajaram, & Tiongson, 2007; Hong & Ahmed, 2009; Haldar, 2009; Haldar & Mallik, 2010; Chowdhury, S. 2010). Fan, Zhang, and Rao (2004) have examined the role of public spending in the context of poverty reduction in rural India; whereas, the study of Fan, Jitsuchon, and Methakunnavut (2004) is related to the rural Uganda. A positive role of government spending on poverty reduction has been observed in both the studies. Jha et al. (2001) have used panel data regression method over the period from 1957 to 1997, keeping state as unit of analysis. Their findings strongly support the impact of development expenditure on rural poverty reduction in India. Shariff et al. (2002) have studied the effect of social sector spending on poverty alleviation in India. Using quantile regressions in cross-country data, Gomanee et al. (2003) have observed the effect of aid on human development outcomes; where there are differences across quantiles, aid is more effective in countries below the median of the welfare distribution. In the same line of thought, Mosley et al. (2004) have devised a 'pro-poor public expenditure index' and observed the evidence that together with inequality and corruption, this is a key determinant of the aid's poverty leverage. After presenting empirical evidence, which suggests a positive leverage of aid donors on pro-poor expenditure, they argued for the development of conditionality in a new form, which gives greater flexibility to donors in pursuing slippage on previous commitments and keys aid disbursements to performance in respect of policy variables that governments can influence in a pro-poor direction. Gupta and Mitra (2004) have used panel data set for 15 major states in five points of time and examined the causality among poverty, health status, health expenditure, and economic growth in India. Their findings support the fact that higher public health expenditure improves health status and reduce poverty.

Following a brief review of the principles guiding public spending and some factors determining the impact of public spending on the poor, Wilhelm and Fiestas (2005) have examined the evolution of the composition of expenditures in nine countries, the extent to which social sector expenditures are captured by the poor, and factors that are likely to affect the efficiency and effectiveness of expenditures in achieving improved sectoral outcomes; they have observed that in a period of declining overall spending in per capita terms, spending increased most significantly in non-productive sectors (except for education). Moreover, spending in sectors that are generally seen as pro-poor tended to benefit the richer quintiles of the population except for primary education, although there are large variations across countries. Paternostro et al. (2007) have investigated the conceptual foundations and the empirical basis for the belief that poverty can be reduced through targeted public spending; a review of literature confirms the lack of an appropriate theoretical framework for assessing the impact of public spending on growth as well as poverty. With regard to the impact of any given type of public spending, they suggested that policy recommendations must be tailored to countries and should be based on empirical analysis that takes into account the lags and leads in their effects on equity, growth, and poverty. Using panel data from 14 Indian states between 1990 and 2002, Hong and Ahmed (2009) have empirically examined how the share of government spending on public goods such as health, education, and basic infrastructure affects per capita state gross domestic product growth and poverty reduction. This study finds that reallocation of expenditures to raise the share of public goods spending could on an average increase per capita SDP growth rate by up to 2.7 percentage points and reallocation of funds to increase the share of social public goods expenditure (viz. health and education) could on an average reduce poverty by up to 6.6 percentage points. Using a longitudinal data, Haldar (2009) and Haldar and Mallik (2010) have observed that India has been experiencing human capital accumulation led growth at the aggregate level[3].

The most common relationship between poverty and fertility in contemporary less developed countries is positive. Using cross-country data on fertility and social sector spending over 60 years, Chowdhury (2010) has observed that almost all the countries did experience a significant decline of fertility except those countries belonging to Sub-Saharan Africa and few countries in South Asia. Chowdhury has pointed out the fact of low level trap caused by low human capital accumulation, lower spending in social sector, and consequently higher fertility accompanied by higher infant and child mortality. For instance, countries with low fertility levels during the 1980's and 1990's (TFR less than 3.5—Vietnam, Costa Rica, urban Paraguay, and South Africa) and with higher fertility levels (TFR greater than 4.5—Guatemala, Cameroon, Bolivia, and Belize) as well as medium level of fertility (TFR between 3.5 to 4.5—Mexico, Rural India, South Africa, Brazil, El Salvador, Equador, and Paraguay) all showed a positive relationship with poverty (Schoumaker, 2004). Poverty and fertility are jointly determined variables, there exists two-way causality and neither can be determined independently from the other (Basu & Van, 1998; Bhattacharya & Haldar, 2012). The large majority of these studies find that children from large families with inadequate income attain less schooling, an outcome usually attributed to resource dilution, that is, less financial and time investment per child.

## THE CURRENT STUDY

The study seeks to understand the movement of inequality of some selected social sector development *vis-a-vis* deprivation parameters over time spanning from 1972-73 to 2009-10 across 16 major states in India where more than 90% of population live. This is to be done with a view to understand the development convergence in respect of key social development parameters in India. We try to investigate the impact of social sector spending on poverty and fertility reduction in a dynamic panel study framework, keeping social sector expenditure as exogenous variable. Numerous studies have explored the determinants of high fertility as well as poverty in less developed economies, including India.[4]

Therefore, we are not examining in detail about the determinants of poverty and fertility, rather try to find out the importance of human capital investment on fertility and poverty. The present study is distinct from earlier studies mainly on three grounds: on methodological aspect, endogeneity aspect between poverty and fertility as coming out from the theoretical work done by Basu and Van (1998), and impact of social sector spending on fertility and poverty in a panel study framework.

## FRAMEWORK

Couples' demand for higher fertility is not an irrational choice under acute poverty. In a less developed economy characterized by high incidence of poverty where the adult wage is very low, households prefer quantity rather than quality of child (i.e., per child investment). This is because under distress situation and in order to avoid destituteness, families send their children to work instead of sending them to school. Child labor acts as an incentive to the parents to have more children (Basu & Van, 1998). This poses health risks for children and their mothers, detracts from human capital investment, slows economic growth, and worsens wellbeing. Countries with high fertility and wide spread human poverty lag in many development indicators, as reflected for example in their rate of progress toward achievement of the Millennium Development Goals (MDGs). How does poverty as well as fertility respond to the exogenous influence of investment in human capital is represented in Figure 1.

How does the poor benefit from the growth process of the states? In a democratic set up, an increase in State Domestic Product (SDP) generally leads to higher spending on social sector because of higher tax collection. The poor households are generally landless labors or farmers with marginal land holdings or village artisans with traditional crafts. Manual labour service is the major means of earning for them. They earn wages from hired out labour service or imputed wages from self employment. Agricultural growth, especially when brought about by area increase or multiple cropping, would typically expand the employment opportunities for the poor. A second channel is through the increase in real wage rate as demand for employment grows from various sectors of the economy. Employment expansion and wage rate increase are certainly the most direct channels through which the poor benefit. Once these two effects operate, other effects start flowing in. As opportunities for gainful earnings expand, they might acquire small productive assets or invest in skill formation and human capital; and these effects could be substantial for the poor after a particular stage of improvement (Radhakrishna & Panda, 2006).

An exogenous increase in expenditure on education and healthcare directly benefit the poor people. Since private schooling and healthcare are expensive, the poor people cannot afford it.

In a less developed economy with wide spread incidence of poverty, the investment in social sector, that is, education and healthcare, gives enormous return both in the short as well as in the long run. Education does not instantly give returns, it takes time and returns from primary education is found to be maximum return compared to secondary and higher education (Psacharopoulos, 1985). Poor people are not in a position to purchase private healthcare because of financial constraint, in the same way they cannot send their children to privately run schools. Poor people can augment their health stock visiting publicly run healthcare institutions for free. This is the short run or instantaneous benefit. In the long run at the aggregate level, the health stock of the poor people can be increased by way of preventive care like immunization of the children, post and pre-natal care, and so forth (Schultz, 1999). As the survival probability of each child increases, parents do not have to insure themselves by having more children. Another mechanism is about the returns to big family as highlighted by Soares (2005). If parents get utility from the number of offsprings surviving

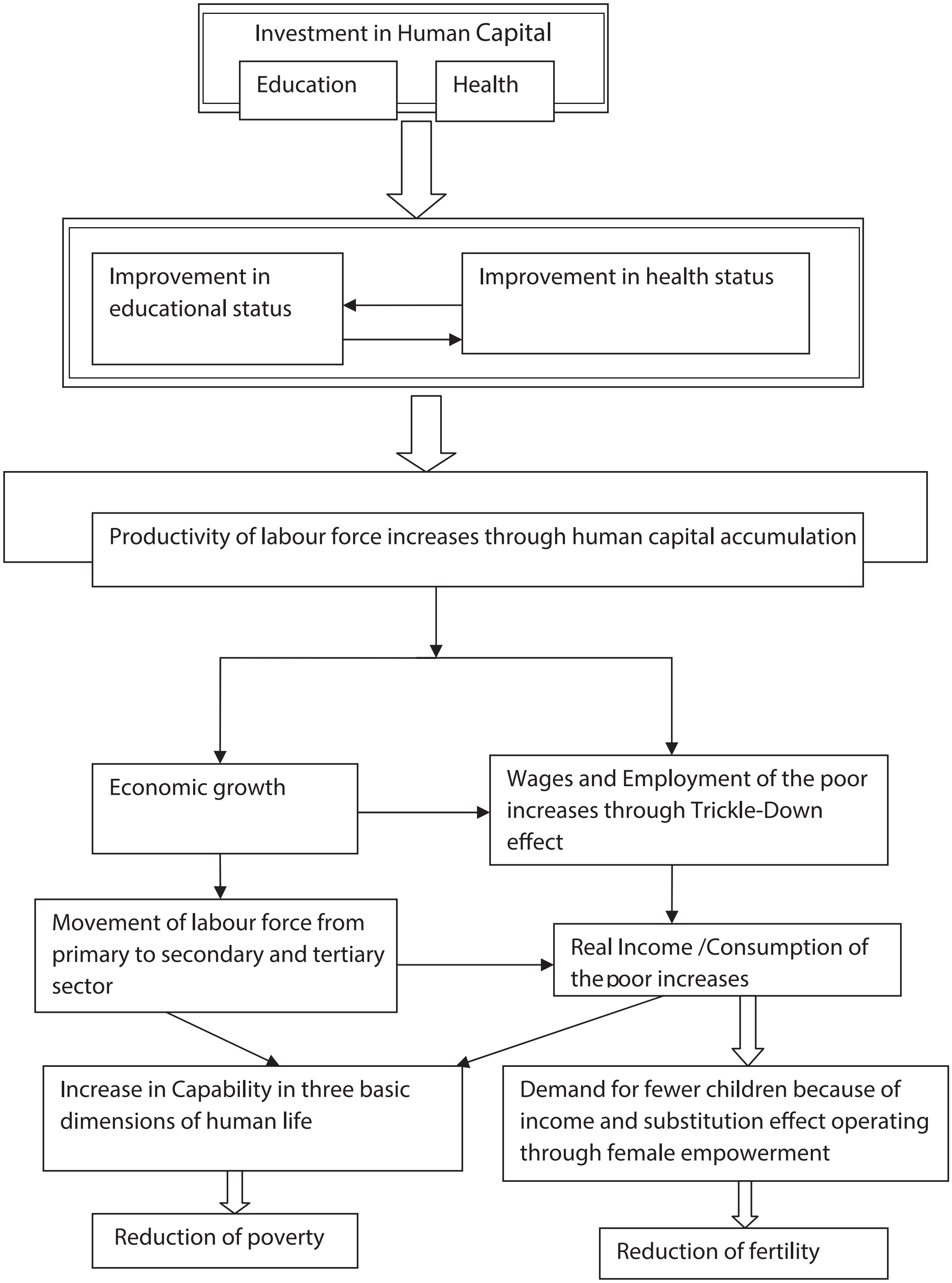



***Figure 1.*** Simple Analytical Flowchart depicting the links between Human Capital Investment and Poverty and Fertility Reduction

into adulthood and raising their own children, decline in child mortality increases the probability of survival to adulthood, therefore, reduces the return to having a large family. Both adult and child mortality declines might induce a quality-quantity trade-off, but the underlying mechanism might differ. In the case of a decline in adult mortality, increases in educational investments driven by higher future return will cause a reduction in fertility. In the case of a decline in child mortality, fall in fertility might cause parents to increase educational investments since now it is cheaper to invest in each surviving child. It is a difficult task to separate out these channels empirically. Accumulation of human capital stock through schooling is a long-run phenomenon. Education, health, nutrition, water, and sanitation complement each other. Therefore, there exists two-way causality between health and educational status of the mass. The productivity of the labor force goes up as a result of accumulation of human capital and it increases the growth of output of the economy. The poorer section of the population may be benefitted through trickle-down effect as a result of economic growth as outlined above. Since human capital at the aggregate level, is non-decreasing (in case of overlapping generations models), the growth of output will be sustaining. The people will move from primary to secondary and tertiary sector as a result of economic growth, which may lead to demand for fewer children. The mechanism through which falling fertility is observed is the female education that raises the opportunity cost of time of the mothers. Since higher quality children are more expensive, the couples now demand fewer children resulting negative income elasticity for the number of children (Barro & Becker, 1989). Reduction of poverty and fertility as a result of exogenous influence of human capital investment can also be explained with the help of Senian concept of development based on Capability Approach.

The mechanism through which poverty as well as fertility decline operates as a result of exogenous shock of public spending on education and health, as depicted in Figure 1, depends on various factors like economic growth of the states, the share of social sector spending of SDP, the concentration of backward community of the states, availability, accessibility, and quality of physical as well as social infrastructure, social as well as economic inequality, good governance, transparency of public distribution system, objective of the political parties who are in power of different state governments, voices of the poor, extent and severity of corruption, socio-political environment, and many others (Aghion, Caroli, & Garcia-Penalosa, 1999; Singh & Srinivasan, 2006; Wagle, 2009; Pal & Ghosh, 2012; Ravallion, 2013). Health and educational development in the public sector is the primary responsibility of state and local governments under the Indian constitution. The Central government plays a supplementary role in national level policy formulation and financial help for undertaking some programmes initiated by it. There has been a wide spread disparity in respect of per capita social sector expenditure as well as poverty and fertility level among the major 16 states in India. All the states are not equally performing in reducing poverty and fertility over time. However, a cluster of states have emerged, which are found to be backward in respect of key social sector development parameters. This is elaborated in the following section using Figure 2 to Figure 6.

## METHODS

We have used secondary data from different official sources in India. The variables, their notations, and sources of data are given in Table 1.

Before formulation of econometric models, we first try to analyze the movement of inequality of some major outcome and input indicators relating to social sector development in India. These are total fertility rate (TFR), infant mortality rate (IMR), poverty measured by head-count ratio (HCR), per capita social sector expenditure (SSE), per capita state domestic product (SDP), and female literacy rate (FLR). The SSE is not

**Table 1**
*Description of the Variables*

| Variables | Abbreviation | Data Source |
|---|---|---|
| Total Fertility Rate | TFR | Sample Registration System, Registrar General, Government of India; available at Family Welfare Year Book, Ministry of Health and Family Welfare, Govt. of India |
| Poverty measured by Head Count Ratio | HCR | Collected and compiled by National Sample Survey Organization (NSSO), various rounds, Government of India; available at Planning Commission, Govt. of India |
| Infant Mortality Rate | IMR | Sample Registration System, Registrar General, Government of India; available at Family Welfare Year Book, Ministry of Health and Family Welfare, Govt. of India |
| Per Capita Human Capital Investment (viz. Per Capita Social Sector Expenditure on Health and Education) | SSE | Central Statistical Organization (CSO), Government of India |
| Per Capita State Domestic Product | SDP | Reserve Bank of India as well as Central Statistical Organization, Govt. of India |
| Female Literacy Rate | FLR | Census Reports, Registrar General, Govt. of India. FLR other than decadal time points are estimated using simple average growth methods |

an outcome rather it is treated as input or process variable affecting the HCR and TFR through different channels as described in Figure 1.

With the panel data, the dependent variable is observed over time, opening up the possibility of estimating parameters of dynamic models that specify the dependent variable for an individual to depend in part on its values in previous periods.

The literature on dynamic panel data recently admitted that GMM (Generalized Method of Moments) is the most popular way of estimating such models (Ahn & Schmidt, 1995, 1997). GMM estimation typically proceeds by considering a set of orthogonality conditions for the model in first difference (to eliminate the individual effect), and building an instrument matrix from dependent variables lagged two periods or more (Arellano & Bond, 1991; Blundell & Bond, 1998).

Following Greene (2008), the standard dynamic panel data model can be written as:

$$y_{it} = X_{it}^{/}\beta + \delta y_{i(t-1)} + u_{it} \quad (1)$$

where, $u_{it} = \mu_i + \nu_{it}$, the rows of the T x K data matrix $X_i$ are $X_{it}^{/}$.

The basic assumptions of the model are:

1. Strict Exogeneity, i.e., $E[\nu_{it} | X_i, \mu_i]=0$, 2. Homoscedasticity, i.e., $E[\nu_{it}^2 | X_i, \mu_i]=\sigma_\nu^2$
2. Non-Autocorrelation, i.e., $E[\nu_{it}\nu_{is} | X_i, \mu_i]=0$, if $t\neq s$, 4. Un-correlated observations, symbolically we can write: $E[\nu_{it}\nu_{js} | X_i, \mu_i, X_j, \mu_j]=0$, if $i\neq j$ for all t and s.

We do not assume mean independence and further assume that the number of time periods, T is fixed and for convenience of our analysis we drop the exogenous variables such that the equation (1) becomes:

$$y_{it} = \delta y_{i.t-1} + u_{it} \quad (2)$$

for i=1, ………..., N and t=1, …………., T

Baltagi (2008) has uniquely described the Arellano-Bond estimation procedure. According to Arellano and Bond (1991), if one utilizes the orthogonality conditions existing between lagged values of the dependent variable ($y_{it}$) and the disturbance term($\upsilon_{it}$), additional instruments can be obtained in a dynamic panel data model. For example, consider a simple autoregressive model with no regressor.

$$y_{it} - y_{i,t-1} = \delta(y_{i,t-1} - y_{i,t-2}) + (\nu_{it} - \nu_{i,t-1}) \quad (3)$$

($v_{it}$ – $v_{i,t-1}$) is Moving Average (1) [MA(1)] with unit root.

For t = 3, the first period of the relationship that being observed is

$$y_{i3} - y_{i2} = \delta(y_{i2} - y_{i1}) + (\nu_{i3} - \nu_{i2})$$

In this case, $y_{i1}$ is a valid instrument, since it is highly correlated with ($y_{i2}$ – $y_{i1}$) and not correlated with ($v_{i3}$ – $v_{i2}$) as long as $v_{it}$ are not serially correlated.

But for t = 4, the second period observed in equation (3) is

$$y_{i4} - y_{i3} = \delta(y_{i3} - y_{i2}) + (\nu_{i4} - \nu_{i3})$$

In this case, $y_{i2}$ as well as $y_{i1}$ are valid instruments for ($y_{i3}$ – $y_{i2}$), since both $y_{i2}$ and $y_{i1}$are not correlated with ($v_{i4}$ – $v_{i3}$). One can continue in this fashion, by adding an extra valid instrument with each forward period, so that for period T, the set of valid instruments becomes $(y_{i1}, y_{i2}, ......., y_{i,T-2})$.

This instrumental variable procedure still does not account for the differenced error term in equation (3). In fact,

$$E(\Delta\nu_i \Delta\nu_i') = \sigma_\nu^2 G \quad (4)$$

where $\Delta\nu_i = (\nu_{i3} - \nu_{i2}, ......, \nu_{iT} - \nu_{i,T-1})$ and G is (T-2) x (T-2), since $\Delta\nu_i$ is MA(1) with unit root.

Let us define a matrix, $W_i$ whose off-diagonal elements are zero and the successive diagonal elements are: [$y_{i1}$], [$y_{i1,}$ $y_{i2}$], [$y_{i1}$, $y_{i2}$ $y_{i3}$]…………………….. [$y_{i1}$, $y_{i2,}$ $y_{i3}$,…$y_{i(T-2)}$]

Then, the matrix instruments is

$$W = [W_1', ........, W_N')' ] \quad (5)$$

and the moment equations described above are given by $E(W_i' \Delta\nu_i) = 0$. These moment conditions have also been pointed out by Holtz-Eakin (1994) and Ahn and Schmidt (1995).

Premultiplying the difference equation (3) in vector form by $W'$, one gets

$$W'\Delta y = W'(\Delta y_{-1})\delta + W'\Delta\nu \quad (6)$$

If one conducts GLS on equation (6), the Arellano-Bond preliminary one-step consistent estimator can be obtained as:

$$\hat{\delta}_1 = [(\Delta y_{-1})'W(W'(I_N \otimes G)W)^{-1}W'(\Delta y_{-1})]^{-1} \times [(\Delta y_{-1})'W(W'(I_N \otimes G)W)^{-1}W'(\Delta y)] \quad (7)$$

If $V_N = \sum_{i=1}^{N} W_i'(\Delta\nu_i)(\Delta\nu_i)'W_i$ and T is fixed,

Hsiao(1986) showed that $W'(I_N \otimes G)W = \sum_{i=1}^{N} W_i' G W_i$

can be replaced by $V_N = \sum_{i=1}^{N} W_i'(\Delta\nu_i)(\Delta\nu_i)'W_i$.

This GMM estimator of $\delta_1$ requires no knowledge concerning the initial conditions or the distributions of $\nu_i$ and $\mu_i$. To operationalize this estimator, $\Delta v$ is replaced by differenced residuals obtained from the preliminary consistent estimator $\hat{\delta}_1$. The resulting estimator is the two-step Arellano-Bond GMM estimator.

$$\hat{\delta}_2 = [(\Delta y_{-1})' W \hat{V}_N^{-1} W' (\Delta y_{-1})]^{-1} [(\Delta y_{-1})' W \hat{V}_N^{-1} W' (\Delta y)] \quad (8)$$

A consistent estimate of the asymptotic $\mathrm{var}(\hat{\delta}_2)$ is given by the first term in equation (8),

$$\widehat{\mathrm{var}}(\hat{\delta}_2) = [(\Delta y_{-1})' W \hat{V}_N^{-1} W' (\Delta y_{-1})]^{-1} \quad (9)$$

## PROBLEM OF ENDOGENEITY IN PANEL DATA

There are two methods developed in connection with the problem of endogeneity in panel data, one by Hausman and Taylor's (1981) and other one by Bhargava and Sargan's (1983). In our empirical model, we have followed the former. The methodological issues are presented here very briefly as follows. Equation (1) is modified as:

$$y_{it} = X_{1it}^{/} \beta_1 + X_{2it}^{/} \beta_2 + Z_{1i}^{/} \alpha 1 + Z_{2i}^{/} \alpha 2 + \varepsilon_{it} + u_i \quad (10)$$

Let us define, $\beta = \left(\beta_1^{/}, \beta_2^{/}\right)^{/}$, $\alpha = \left(\alpha_1^{/}, \alpha_2^{/}\right)^{/}$. All individual effects denoted as $z_i$ are observed. Unobserved individual effects that are contained in $z_i^{/}\alpha$ represents the person specific random term, $u_i$. Hausman and Taylor (1981) defined four sets of observed variables in their model as $X_{1it}$ is $K_1$ variables that are time varying and uncorrelated with $u_i$. $Z_{1it}$ is $L_1$ variables that are time invariant and uncorrelated with $u_i$. $X_{2it}$ is $K_2$ variables that are time varying and correlated with $u_i$. $Z_{2it}$ is $L_2$ variables that are time invariant and correlated with $u_i$. The assumptions of the random terms in the model are:

$E[u_i | X_{1it}, Z_{1i}]=0$, though $E[u_i | X_{2it}, Z_{2i}] \neq 0$; $Var[u_i | X_{1it}, Z_{1i}, X_{2it}, Z_{2i}] = \sigma_u^2$;

$Cov[\varepsilon_{it}, ui | X_{1it}, Z_{1i}, X_{2it}, Z_{2i}]=0$; $Var[\varepsilon_{it} + ui | X_{1it}, Z_{1i}, X_{2it}, Z_{2i}] = \sigma^2 = \sigma_\varepsilon^2 + \sigma_u^2$

$Correl.[\varepsilon_{it} + u_{it}, \varepsilon_{is} + u_{it} | X_{1it}, Z_{1i}, X_{2it}, Z_{2i}] = \rho = \sigma_u^2/\sigma^2$. Following Generalized Methods of Moments, Hausman and Taylor (1981) have estimated the parameters of equation (10). A detailed note is available in Baltagi (2008) and Greene (2008).

We have formulated two models in our present study. In the first model, we hypothesize that current fertility and poverty is influenced by past periods of fertility, poverty, social sector expenditure, and infant mortality rate. We have carried out a dynamic panel data regression of the first model given by the equations (11) and (12) to find out the impact of the factors mentioned above. It is assumed that human capital investment (viz. SSE) does not instantaneously affect the poverty and fertility; it has a long term effect. This is why we have taken lagged values by five years. We could have incorporated other past values but due to collinearity problem we have dropped other lagged values of human capital investment. Five years lagged values of per capita human capital investment is not arbitrarily taken. Optimal lag is generally determined by Akaike Information Criterion(AIC) and Schwarz Bayesian Criterion(SBC) criterion in pure time series econometrics. In our present study, we have chosen five years from trial and error methods and in most of the states, five years lag is found to be optimal, however, few states exhibit six and seven years of lag. The impact of income, education especially female education, urbanization, child labor, female labor force participation, son preference, female age at marriage, and so forth are well established factors influencing fertility and this is why we deliberately exclude all these variables from our model. Mortality decline among infants and children causes a surge in the numbers of surviving children and an increase in the proportion of the population in the childhood ages. A decline in mortality increases the chances of survival of the young, as well as their life expectancy. With children more likely to survive and live longer, parents are less likely to want to have more children, leading to a decline in fertility, and instead, invest their resources in fewer children. In other words, there is a decline in the "quantity" of children and an increase in the "quality" of children. Hence, lower mortality and fertility, comes with a lag with giving some time to parents for their decision making from higher to lesser number of children. This is why IMR is included as one of the exogenous variables in our fertility model as described by equation (11). However, the logic to include IMR in poverty model (viz. equation-12) is quite different. Here, one period lagged value of IMR is treated as initial health stock, lower IMR means higher health stock and vice-versa. Children with lower health stock cannot perform well in school, which impedes the process of knowledge acquirement. Most of the times these children dropout from school and join in the unskilled labor force of unorganized sector, which negatively affects in future income generation and poverty reduction. Lagged TFR and HCR are included in our model to examine the validity of low level trap. How are the current HCR as well as TFR affected by initial base values? In order to answer this, we incorporate the lagged values in our model.

In order to address the problem of endogeneity between poverty and fertility, we consider model 2 given by the equations (13) and (14), in which current fertility is determined by current poverty. Similarly, current poverty is also determined by current fertility. Under destitute situation in a rural economy, there exist two-way causality between higher fertility and abject poverty as argued by Basu and Van (1998). Thus, HCR and TFR are treated as endogenous and all other variables are exogenous and pre determined. We have chosen log linear form in order to find out the values of elasticity of the predictors.

**Model-1**

$$TFR_{it} = \alpha_0 . TFR_{i(t-1)}^{\alpha_1} . HCR_{i(t-j)}^{\alpha_2} . IMR_{i(t-1)}^{\alpha_3} . SSE_{i(t-j)}^{\alpha_4} . e^{u_{it}} \quad (11)$$

$$HCR_{it} = \beta_0 . HCR_{i(t-j)}^{\beta_1} TFR_{i(t-1)}^{\beta_2} . IMR_{i(t-1)}^{\beta_3} . SSE_{i(t-j)}^{\beta_4} . e^{v_{it}} \quad (12)$$

**Model-2**

$$TFR_{it} = \alpha_0 . HCR_{it}^{\alpha_1} . TFR_{i(t-j)}^{\alpha_2} . IMR_{i(t-1)}^{\alpha_3} . SSE_{i(t-j)}^{\alpha_4} . e^{u_{it}} \quad (13)$$

$$HCR_{it} = \beta_0 . TFR_{it}^{\beta_1} HCR_{i(t-j)}^{\beta_2} . IMR_{i(t-1)}^{\beta_3} . SSE_{i(t-j)}^{\beta_4} . e^{v_{it}} \quad (14)$$

Here, i=1,2………..16; t=1,2……7 .

All the error terms in equations (11) to (14) consist of two parts—the fixed effect and the random effect.

There are eight points of time in which the data on poverty across the 16 major states are available in India. We have assumed that current TFR is determined by its one period lagged value and HCR is determined by its past values (lagged by 4 years), we have the scope to build up dynamic panel data models for TFR and HCR.

## RESULTS

Before going to analyze the econometric estimation, we first try to see how the 16 major states did progress in key social sector development parameters as well as in reduction of poverty over time, that is, 1972-73 to 2009-10. We have presented the following figures (Figure 2 to Figure 6) in which the comparative pictures of all states over two points of time (1972-73 to 2009-10) are shown in respect of HCR, Per Capita SSE, TFR, IMR, and Female Literacy Rate (FLR). It is observed that during the last 37 years, some major states (like Himachal Pradesh, Kerala, Punjab, and Tamil Nadu) were capable of reducing the HCR at a significant level but the opposite phenomenon is observed among the states like Bihar, Assam, Madhya Pradesh, Orissa, and Uttar Pradesh. All these states show a higher incidence of HCR above 30%.

Now, if we look at the decline of TFR over the same period as shown in Figure 3, one can make a conjecture about the decline of HCR and TFR among the states. Almost half of the major states experienced rapid decline of TFR (less than 2) but the TFR is found to be quite high (above 3) in the

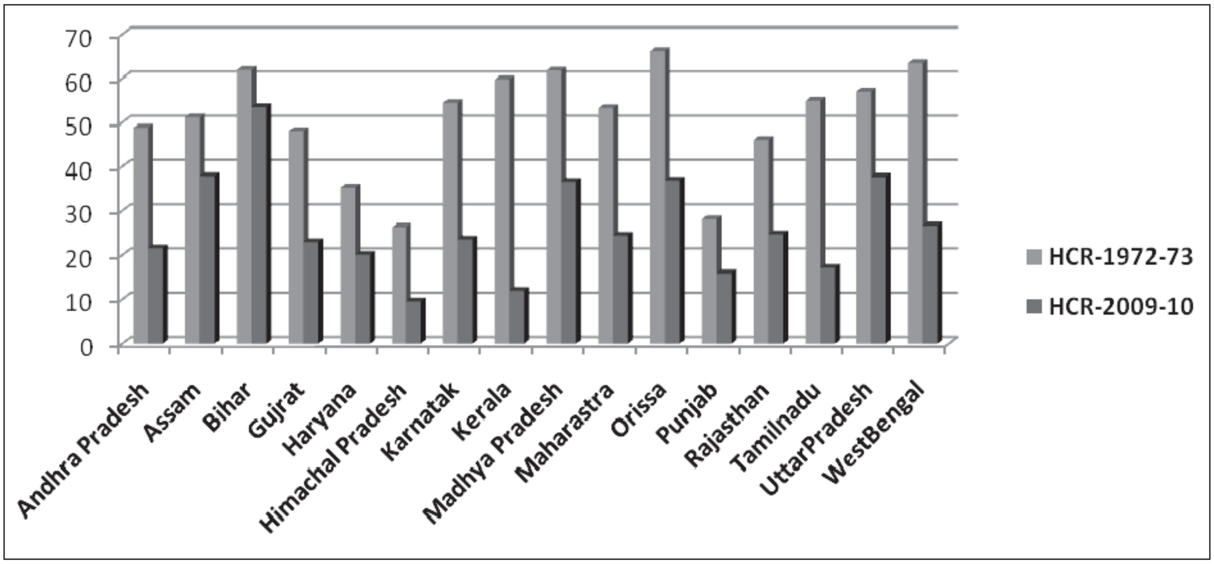



***Figure 2.*** HCR of 16 Major States at two points of time (viz. 1972-73 and 2009-10)

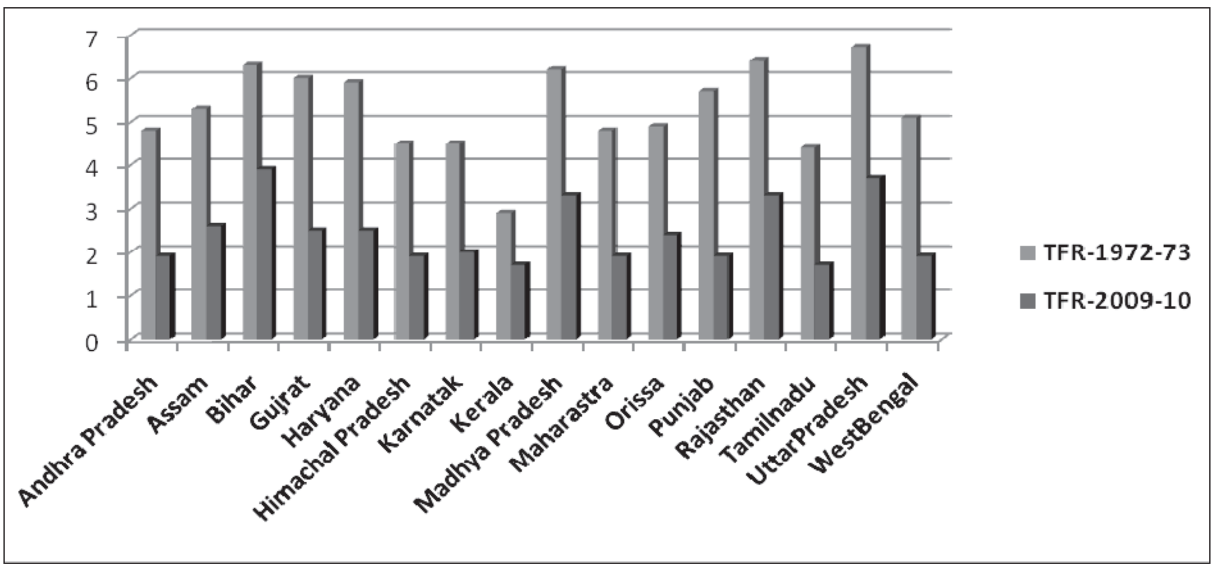



***Figure 3.*** TFR of 16 Major States at two points of time (viz. 1972-73 and 2009-10)

states like Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh.

IMR is assumed to be an important indicator of health status. For the last 37 years, all the states had witnessed a spectacular decline of IMR but the pace of decline does vary to a large extent. This is shown in Figure 4.

A few states like Kerala, Maharashtra, Punjab, Tamil Nadu, and West Bengal have performed well in reducing the IMR (less than 40) but the bigger states like Assam, Madhya Pradesh, Orissa, Bihar, Rajasthan, and Uttar Pradesh could not reduce the IMR lower than 50. FLR is an important indicator of social development. Most of the bigger states (in respect of population size) like Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, and Andhra Pradesh could not exceed 60% of FLR. Kerala,

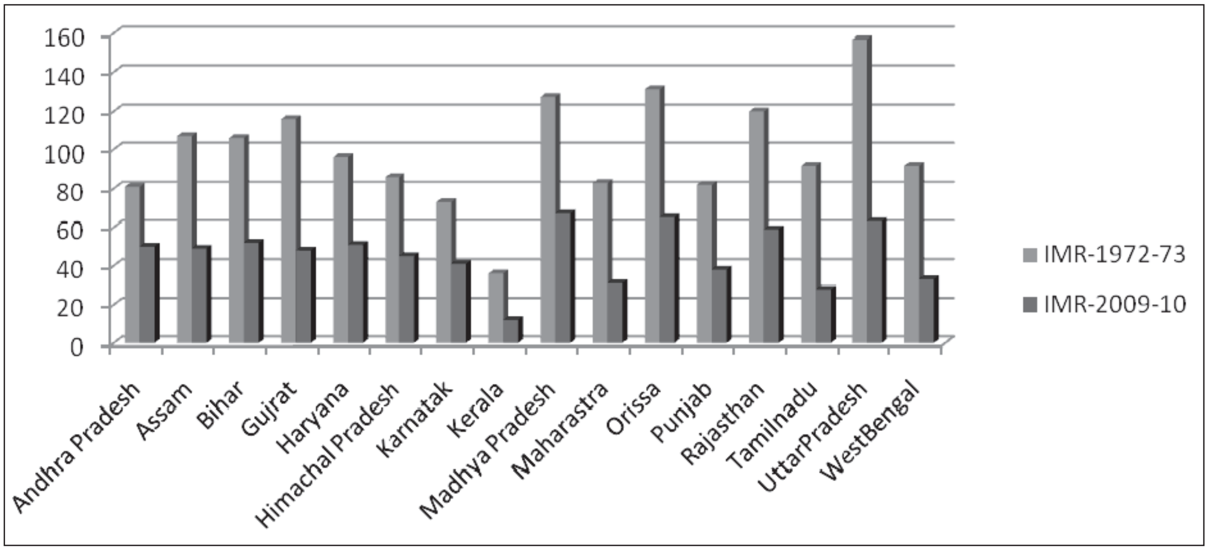



*Figure 4.* IMR of 16 Major States at two points of time (viz. 1972-73 and 2009-10)

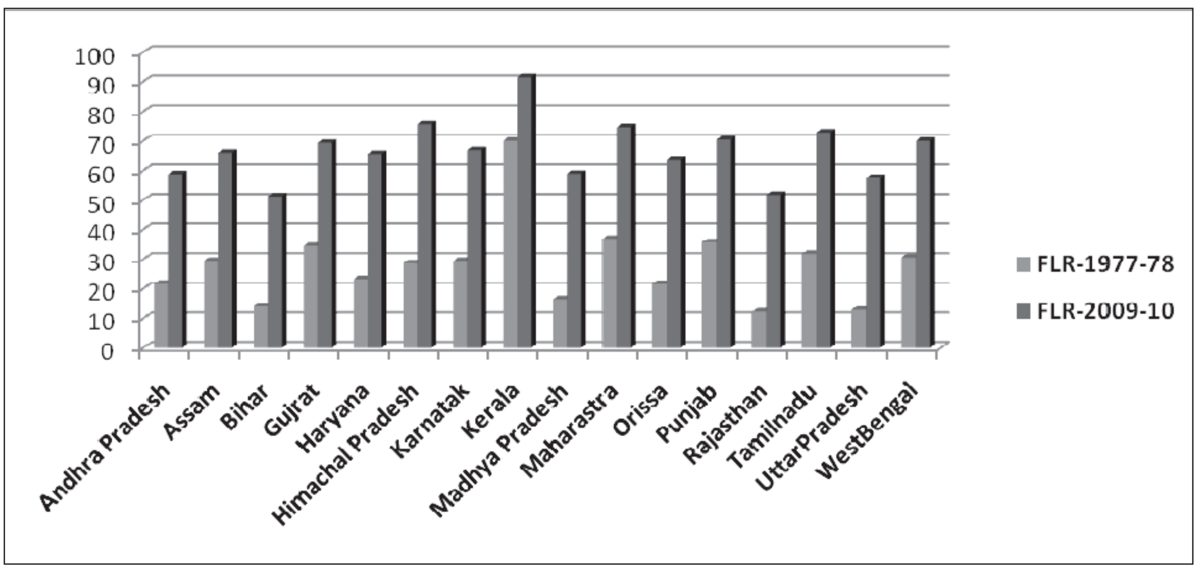



*Figure 5.* FLR of 16 Major States at two points of time (viz. 1972-73 and 2009-10)

Himachal Pradesh, Maharashtra, and Tamil Nadu achieved more than 70% FLR.

FLR, TFR, IMR, and HCR all are the development outcome variables. Let us now see the progress of the per capita SSE among the states over 1972-73 to 2004-05. This is shown in Figure 6.

The per capita SSE of all the states in 1972-73 were very poor (less than Rs.50) but during 2009-10, it has increased many folds but still it seems very low compared to the countries similarly placed like India. Himachal Pradesh, Punjab, and Kerala spend more than Rs.600 on per capita SSE but bigger states like Bihar, Madhya Pradesh, Orissa, Rajasthan, and Uttar Pradesh spend between Rs. 200 to Rs.400. Such a wide spread differential of per capita SSE among the states certainly do have some impact

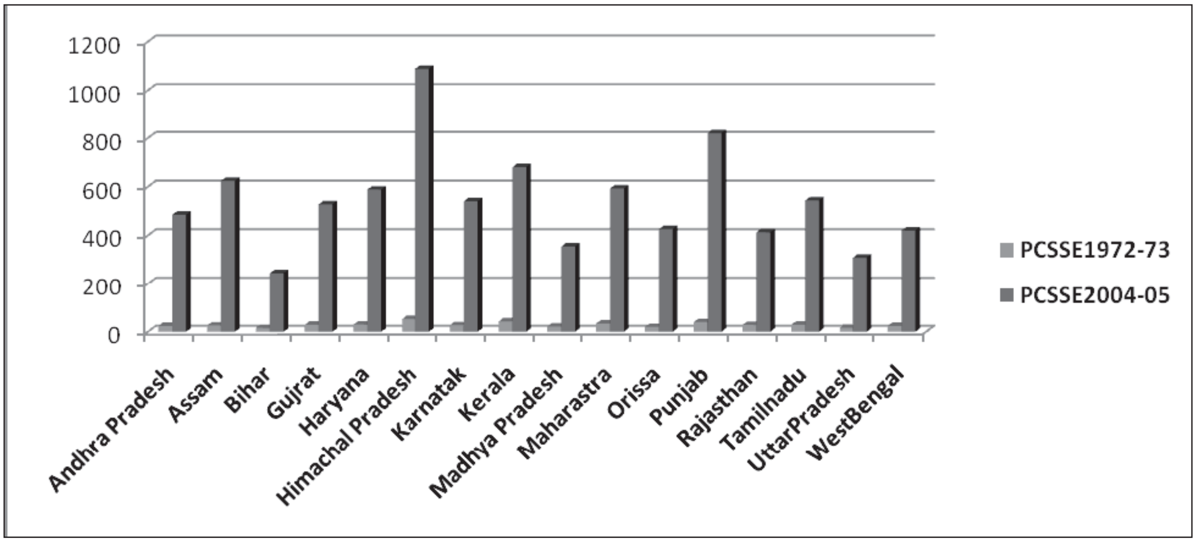



***Figure 6.*** Per Capita SSE of 16 Major States at two points of time (viz. 1972-73 and 2009-10)

on social development, namely, fertility and poverty reduction. We shall explore this in the next section. Does India experience inclusive growth? Is inequality rising in respect of selected economic and social development parameters? Are the states converging? All are analyzed in the following section:

In Table 2, we have estimated the movement of inequality of the variables included in our econometric models. We have also studied the movement of inequality of two additional variables—Per Capita State Domestic Product (PCDDP) and Female Literacy Rate (FLR) in order to get a clear understanding of convergence across the states. Here, PCDDP is treated as economic variable and FLR is treated as gender sensitive social development parameter.

On the basis of the calculated values of Table 2, Figure 7 has been drawn to show the trend of the inequality of a number of variables mentioned above over the period from 1973 to 2010.

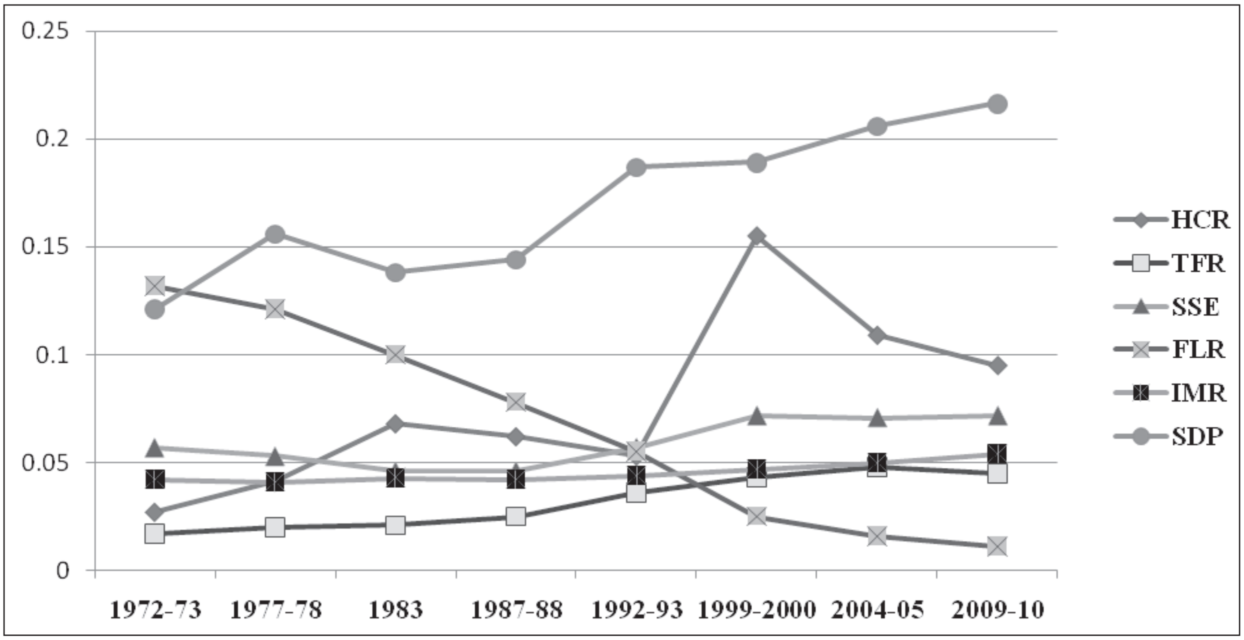
We are not examining the β (beta) and σ (sigma) convergence already applied in growth empirics but we have measured the inequality

**Table 2**

*Inequality of selected socio-economic variables in different time points across 16 major states of India*

| Time | HCR | SDP | SSE | IMR | TFR | FLR |
|---|---|---|---|---|---|---|
| 1972-73 | 0.027 | 0.121 | 0.057 | 0.0421 | 0.017 | 0.132 |
| 1977-78 | 0.041 | 0.156 | 0.053 | 0.041 | 0.020 | 0.121 |
| 1983 | 0.068 | 0.138 | 0.046 | 0.043 | 0.021 | 0.100 |
| 1987-88 | 0.062 | 0.144 | 0.046 | 0.042 | 0.025 | 0.078 |
| 1992-93 | 0.053 | 0.187 | 0.057 | 0.044 | 0.036 | 0.055 |
| 1999-2000 | 0.155 | 0.189 | 0.072 | 0.047 | 0.043 | 0.025 |
| 2004-05 | 0.109 | 0.206 | 0.071 | 0.050 | 0.048 | 0.016 |
| 2009-10 | 0.095 | 0.2165 | 0.072 | 0.054 | 0.045 | 0.011 |

Note: Inequality is measured using Generalized Entropy measure using a=2 because it gives equal weights of the distribution. Authors estimation.




Drawn on the basis of Table-2

***Figure 7.*** Inequality Trend of selected socio-economic variables

among the 16 major states for eight time points on various socio-economic development parameters as cited above. A rising trend of inequalities is found in respect of PCSDP, HCR, Per Capita SSE, IMR, and TFR. This means that the states are not converging in respect of those selected variables. The inequality in FLR shows a declining trend. Since FLR has some asymptotic upper bound (100%), we have obtained such results. The same result is obtained in respect of life expectancy at birth but this is not reported here.

The Arellano-Bond dynamic panel result is robust. It captures the dynamic feed-back loop between endogenous variable and one period lag values of endogenous variable. How the initial endowment of two endogenous variables like TFR and HCR affect the current TFR and HCR respectively is well captured by Arellano-Bond dynamic panel study. Initial (one period lagged) fertility elasticity of current fertility is found to be positive and it is statistically significant at three percent level. Over the period of the study, holding all other variables fixed, a one percent increase in lagged TFR leads on the average to about 0.127 percent increase in the current TFR. Similarly, a one percent increase in IMR (lagged by one period) raises on an average to about 0.24 percent increase in the current TFR. In the same way, holding all other variables constant, a one percent increase in per capita SSE (lagged by five periods) leads to reduce current TFR by 0.136 percent. Lagged HCR is dropped from the model because of collinearity problem. The mortality (IMR) elasticity of fertility (TFR) appears to be very high and it is statistically significant at one percent level. States experiencing higher IMR generally manifest higher TFR. This finding is not new, rather it strongly supports the positive association between TFR and IMR in a dynamic panel study framework. A close look of the positive association between TFR and IMR as revealed from the present study has a strong micro foundation of macro development process. Keeping in mind the causality between TFR and IMR, child survival strategies as adopted by many state governments (like Kerala, Tamil Nadu, Maharashtra, Himachal Pradesh, West Bengal, Karnataka, and Punjab) during

**Table 3**

*Dynamic Panel Data Regression Results: [Arellano-Bond Two Steps Methods]*

| Endogenous Variable= lnTFR<br>Arellano-Bond dynamic panel-data estimation, Number of observations=80<br>Group variable: State Number of States =16<br>Time variable: year, Observation per group: 5<br>Number of instruments =19 Wald chi2(3) = 5288.72, Prob > chi2 = 0.0000 | | | | |
|---|---|---|---|---|
| Explanatory Var. | Coeff. | Std. Error | Z | P>\|z\| |
| $\ln TFR_{(-1)}$ | 0.1275 | 0.0597 | 2.14 | 0.033 |
| $\ln HCR_{(t-j)}$ | Dropped because of Multicollinearity | | | |
| $\ln IMR_{(-1)}$ | 0.2446 | 0.0309 | 7.92 | 0.000 |
| $\ln SSE_{(t-5)}$ | -0.1364 | 0.0141 | -9.67 | 0.000 |
| Constant | 0.6654 | 0.1836 | 3.62 | 0.000 |
| Endogenous Variable= lnHCR<br>Arellano-Bond dynamic panel-data estimation, Number of observations = 96<br>Group variable: State Number of States =16<br>Time variable: year, observation per group: 6<br>Number of instruments =13 Wald chi2(3) = 768.71, Prob > chi2= 0.0000 | | | | |
| Explanatory Var. | Coeff. | Std. Error | Z | P>\|z\| |
| $\ln HCR_{(t-j)}$ | 0.3111 | 0.0551 | 5.64 | 0.000 |
| $\ln TFR_{(-1)}$ | -0.1813 | 0.1470 | -1.23 | 0.217 |
| $\ln IMR_{(-1)}$ | Dropped because of Multicollinearity | | | |
| $\ln SSE_{(t-5)}$ | -0.1976 | 0.0232 | -8.49 | 0.000 |
| Constant | 3.517 | 0.1958 | 17.96 | 0.0000 |

Source: Authors estimation.

late 1980's resulted to a faster decline of TFR. Human capital investment (SSE) lagged by five years is found to have a profound and significant impact on current TFR. Lagged human capital investment elasticity of fertility is statistically significant in our model. It is observed that there is a high degree of interstate variations of per capita SSE, such a variations of SSE strongly affect the current fertility status of the states. What we have hypothesized earlier strongly support the present findings. Therefore, we can argue that the dynamic panel study partially supports the theory of endogenous growth models developed by Lucas(1988), Schultz(1997), & Becker(1993). This also supports the Sen's(1997) view of Capability Approach of development.

Similarly, the current HCR (as described by equation 12) is well explained by lagged HCR and per capita SSE lagged by five years; the model drops IMR because of multicollinearity. A one percent increase in lagged HCR raises the current HCR by 0.311 percent on an average, holding all other variables constant. A one percent increase in per capita SSE (lagged by five years) leads to the reduction of current HCR by 0.197 percent. Here, one period lagged TFR does not appear to cause current HCR. Human capital investment (SSE) again appeared as the most significant predictor in reducing the current HCR as well as current TFR.

**Table 4**

*Hausman-Taylor's Estimation of Endogeneity in Dynamic Panel*

| Estimated Result of Equation-13<br>Dependent Variable= $\ln TFR_t$ Endogenous Variable: $\ln HCR_t$<br>Hausman-Taylor's panel-data estimation of Endogeneity, Number of observations=112<br>Group variable: State, Number of Groups/States =16, Observation per group: 7<br>Wald $chi^2(6)$ = 2064.11, Prob > $chi^2$ = 0.0000 | | | | |
|---|---|---|---|---|
| Explanatory Var. | Coeff. | Std. Error | Z | P>\|z\| |
| $\ln HCR_t$ | 0.08462 | 0.0274 | 3.09 | 0.002 |
| $\ln TFR_{(t-1)}$ | 0.6743 | 0.0681 | 9.90 | 0.000 |
| $\ln IMR_{(-1)}$ | 0.1013 | 0.0437 | 2.32 | 0.02 |
| $\ln SSE_{(t-5)}$ | -0.1289 | 0.0304 | -4.23 | 0.000 |
| T(Time/Year) | -0.0339 | 0.0161 | -2.11 | 0.035 |
| Group | 0.0008 | 0.0047 | -0.18 | 0.857 |
| Constant | 0.6654 | 0.1836 | 3.62 | 0.000 |
| Estimated Result of Equation-14<br>Dependent Variable= $\ln HCR_t$ Endogenous Variable: $\ln TFR_t$<br>Hausman-Taylor's panel-data estimation of Endogeneity, Number of observations=112<br>Group variable: State, Number of Groups/States =16, Observation per group: 7<br>Wald $chi^2(6)$ = 244.42, Prob > $chi^2$ = 0.0000 | | | | |
| Explanatory Var. | Coeff. | Std. Error | Z | P>\|z\| |
| $\ln TFR_t$ | 0.9853 | 0.3339 | 2.95 | 0.003 |
| $\ln HCR_{(t-j)}$ | Dropped because of Multicollinearity | | | |
| $\ln IMR_{(t-1)}$ | 0.2575 | 0.1599 | 1.61 | 0.107 |
| $\ln SSE_{(t-5)}$ | -0.6195 | 0.0981 | -6.31 | 0.000 |
| T(Time/Year) | -0.2443 | 0.0537 | 4.55 | 0.000 |
| Group | 0.00508 | 0.0184 | 0.32 | 0.746 |
| Constant | 3.517 | 0.1958 | 17.96 | 0.0000 |

Note: Group is time invariant exogenous variable; T=Time measured by years.

Following the methodology as outlined above, we have used Hausman-Taylor approach in order to capture the problem of endogeneity as addressed in equations (13) and (14) between current TFR and current HCR. The result is reported in Table 4.

The joint dependence of fertility and poverty is well addressed by the Hauseman-Taylor model. In India, there are few major states like Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar, Orissa, and Assam which could not perform well in reducing fertility (compared to the national average) over time. Consequently, the incidence of poverty as measured by HCR is disproportionately high among all these major states in India. This phenomena is well proven empirically by the Hausman-Taylor model. A one percent increase in current HCR raises the current TFR by 0.08 percent, holding all other variables fixed. In the same way, controlling all other variables, a one percent increase in current TFR induces to increase the current HCR by 0.98 percent. Following the theoretical model developed by Basu and Van (1998), we have just empirically verified the two-way causality between current poverty and current fertility in India at the state level using panel data. This again justifies the existence of low level equilibrium trap caused by higher incidence of poverty accompanied by higher fertility. All the exogenous and pre-determined variables are more or less found to be in expected direction. What is appealing here is the powerful role of social sector spending (SSE) on poverty and fertility decline. The states which spend more on per capita SSE do experience a lower HCR as well as lower TFR. Adequate SSE helps to build human capital formation and the poorer sector of the society are expected to be benefitted to a large extent from such public spending. In both the models (as represented by equations 11-14), SSE appeared as most significant exogenous variable affecting HCR and TFR. There is an advantage of Hausman-Taylor model because one can examine the effect of time and group simultaneously on HCR and TFR. We find that time(year) in model 2 has a negative and significant impact on HCR and TFR, which means that on an average all the states have been experiencing a decline of HCR and TFR. However, the effect of Group (the states) is not found to be significant in both models.

## CONCLUSIONS

Inter-state inequalities of key social and economic development parameters are increasing over time except female literacy rate. Unbalanced and differential socio-economic progress among the states has been a major concern of our planning process. Our development experience is not inclusive. An inter-state variation of poverty and fertility is well explained by per capita health and education (viz. social sector) expenditure along with other important factors. At the aggregate level, country's performance in respect of economic growth is quite spectacular but this economic growth could not benefit to the mass of the society at the disaggregate level; consequently, poverty as well as fertility was not reduced at a significant level among the states like Uttar Pradesh, Madhya Pradesh, Orissa, Bihar, Assam, and Rajasthan. One important fact is that most of the states have reduced their share of education and health expenditure of total expenditure since the inception of structural adjustment programme (viz. 1990-91). Therefore, under the present circumstances, such a poor, inadequate, and insufficient social sector spending has made an obstacle not only for the reduction of poverty and fertility but it also hampers human capital formation and may affect aggregate growth process in the long run. In India where a large segment of population depends largely on public provision of health and education, public investment is not only crucial but also expected to be high in this respect. Incidence of poverty and fertility is disproportionately high among those states that spend a very marginal amount on social sector. National Common Minimum Programme 2005 indicates that the requirements of backward states (in respect of health infrastructure) with relatively poor health indicators (viz. higher TFR and IMR) are higher than that of those states manifesting higher levels of health indicators. Since, health services are principally the responsibility of the state governments, the backward states find it extremely difficult to raise additional funds for meeting the requirements. It is indeed a desirable step adopted by the 12th Finance Commission recommending some level of grants to the backward regions of the backward states. Since health and educational outcome is interdependent, a simultaneous increase in investment in social sector is needed especially among the backward states to lower down the poverty in one hand and to reduce the fertility on the other. Most of our development policies are independent, that is, health policy is independent of poverty eradication programme. Our development policy should be designed in such a way that can address the two vital issues (viz. poverty and fertility) simultaneously for getting a desirable development outcome; this is because of endogeneity between poverty and fertility.

## ACKNOWLEDGEMENTS

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## ENDNOTES

[1]In the earlier neoclassical models, human capital was not considered as a major input for production and hence w as not included in growth models (Harberger, 1998). In the 1960s, the seminal works of Schultz (1960) and Denison (1962) led to a series of growth accounting studies pointing to education's contribution to the unexplained residuals in the economic growth of Western economies. Other studies looked at the impact of education on earnings or estimated private rate of returns (Becker, 1960). In Lucas (1988) Model, agents set aside their own time to generate additional human capital. Human capital becomes directly heritable across generations and generates spillover benefits to the society. Barro and Sala-i-Martin (1995), McMahon (1998), Temple (1999), Bils and Klenow (2000), Self & Grabowski (2004), and Psacharopoulos (1994) found schooling to be positively correlated with the growth rate of per capita Gross Domestic Product across countries.

[2]Following McMahon (1998), Oketch (2006), and Haldar and Mallik(2010), the following implicit production function is considered here:_

$$Y_t = Y(K_t, H_t, N_t) \tag{1a}$$

where, Y = aggregate output, K = stock of physical capital, H = stock of human capital N = aggregate employment of the economy and t = time. Totally differentiating the reduced form of equation (1a), with respect to time t and dividing through by Y, we have:

$$\frac{1}{Y}\left(\frac{\partial Y}{\partial t}\right)=\frac{1}{Y}\left(\frac{\partial Y}{\partial K}\right)\left(\frac{\partial K}{\partial t}\right)+\frac{1}{Y}\left(\frac{\partial Y}{\partial H}\right)\left(\frac{\partial H}{\partial t}\right)+\frac{1}{Y}\left(\frac{\partial Y}{\partial N}\right)\left(\frac{\partial N}{\partial t}\right) \tag{2a}$$

$$y = MP_K.\frac{I_K}{Y} + MP_H.\frac{I_H}{Y} + MP_N.n\frac{N}{Y} \tag{3a}$$

Here, y and n represent rate of growth of output and employment respectively. $I_K$ and $I_H$ stand for investment in physical and human capital respectively. Assume that population grows at an exponential rate, $P_t=P_0.e^{rt}$, subtracting the population growth rate r from both sides of equation (3a), we have:

$$y - r = MP_K.\frac{I_K}{Y} + MP_H.\frac{I_H}{Y} + MP_N.n\frac{N}{Y} - r \tag{4a}$$

Left hand side expression stands for per capita growth rate of output, that is $\frac{\partial}{\partial t}\left(\frac{Y}{P}\right)\div\frac{Y}{P}$, let $\theta = \frac{r}{n}$.

Then the above equation becomes

$$y - r = MP_K.\frac{I_K}{Y} + MP_H.\frac{I_H}{Y} + n\left(MP_N - \theta.AP_N\right)/\ AP_N \tag{5a}$$

Assume the equality between r and n. This assumption is more valid and plausible in the developed western economies or may hold good in the planned economy but it is a restrictive assumption for the underdeveloped countries because of population growth rate is higher than the growth rate of employment. The first and second term of right hand side of equation (5a) is positive but the coefficient of n is negative. One can easily verify this considering a generalized Cobb-Douglas production function.

[3]Using longitudinal data from 1950-51 to 2003-04, Haldar (2009) has found that Lucas type endogenous growth model is more applicable in India compared to physical accumulation and export led growth models. In another study, Haldar and Mallik (2010) have examined the time series behavior of investment in physical capital, human capital (comprising education and health), and output in a co-integration framework and found that human capital investment has significant long-run effect on per capita GNP.

[4]Variations in fertility are generally examined in terms of socio-economic factors such as education in general and female education in particular, income, caste, place of residence, son preference, age at marriage of the female, occupation, female employment, use of contraception and so forth ( Rosenzweig & Evenson, 1977; Mari Bhat, 1998; Visaria, 1999; Murthi, Guio, & Dreze, 1995; Mutharayappa, Choe, Arnold, & Roy, 1997; Bhattacharya & Haldar, 2003; and Arokiasamy, 2009). Following the income-fertility relationship (developed by Becker, 1960, 1993; Schultz, 2009), it is empirically verified that poor households do have larger number of children compared to the rich (Amin, Casterline, & Spess, 2007; National Family Health Survey [NFHS] 2005; Mohanty, 2009). Using NFHS I, II & III, Bhattacharya and Haldar (2012) have shown that females who go outside home for cash demand fewer number of children even under destitute situation. This is because opportunity cost of time is very high among the females who work for survival in a subsistence economy.

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