DETERMINANTS OF TOTAL FERTILITY RATE IN INDIA: EVIDENCES FROM NFHS-4

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ABSTRACT

Family planning is essential for population stabilization and poverty reduction. India is the second most populated nation in the world and its houses with nearly a fifth of the world's population. The Total Fertility Rate (TFR) is children per woman aged 15 to 49 years. The TFR describe the condition of population growth in the country. In order to stabilise the population, TFR should be stable. Surrogate fertility is defined as TFR- 2.1 children per mother and replacement TFR is 2. Below 2 TFR represents the negative growth of population. Any method (in per cent) or contraception, women's literacy (in percent), infant mortality rate (IMR), male literacy, working women during last 12 months, and per capita income are the variables which play significant role in determination of the TFR. The selection of explanatory factors used in this investigation was guided by previous empirical findings and the availability of data. The objective of the study is to identify the variables that influence TFR in India using the secondary data gathered from the National Family Health Survey (NFHS) fourth round state level factsheet 2015-16. The Multiple Linear Regression Model (MLRM) utilised in the study is based on the OLS technique used to analyse the data. It was discovered that the fertility rate is significantly influenced by per capita income and any method (contraceptives).The study's results demonstrate that raising per capita income and promoting family planning and the use of contraceptives improve TFR of the states and nation.

Keywords: *Total fertility rate, Population stabilization, Per capita income, literacy, OLS, NFHS*
JEL classification: J1, J13

Introduction

One of the most important health indicators for determining population growth and stability is the Total fertility rate (TFR). The fertility rate has a direct impact on maternal health, which in turn affects family, community, and the economy of a country as a whole. The overall fertility rate in India is 2.2 children for every woman, down from 2.7 in 2005–2006, and is currently barely above the replacement level of fertility, which are 2.1 children for every woman. In India, the TFR has significantly decreased over time. The TFR has decreased by 1.2 children between 1992-1993 and 2015-16, From a TFR of 3.4 children in 1992-93 to 2.2 children in 2015-16. From 3.7 children in 1992–1993, the TFR among rural women fell to 2.4 children in 2015–2016. Women in urban areas experienced a similar fall, going from having 2.7 children in 1992–1993 to only 1.8 children in 2015–16. No matter where respondents live, the fertility rate in all NFHS surveys peaks between ages 20 and 24, after which it steadily drops (NFHS, 2017).The number of children per woman decreases as women's educational attainment increases. In comparison to women with 12 or more years of education, who have 1.7 children on average, women without any formal education have 3.1 children on average. Jains have the lowest TFR at 1.2 children per woman while Muslims have the highest TFR at 2.6 children per woman. In Sikkim, the TFR is 1.2 children per woman, while in Bihar; it is 3.4 children per woman. All of the southern states, as well as 23 other states and union territories, have fertility rates that are lower than the replacement norm of 2.1 children per woman.

NFHS-4 report describe that as a pregnancy preventive measures in India between 2005-2006 and 2015-2016, the percentage of married women who use modern contraception stayed relatively constant at little around 50 per cent. By far the most common form of contraception, female sterilisation is still used by 36 per cent of women who are currently married. The most often used modern technique of contraception is still female sterilisation. Female sterilisation is used by 36 per cent of currently married women aged 15 to 49, whereas male condoms and tablets are used by 6 per cent and 4 per cent, respectively. Six percent employ a conventional approach, primarily the rhythm approach. The most popular method among sexually active, unmarried women is female sterilisation 19 per

cent, followed by male condoms 12 per cent. According to employment status, 60 percent of women who work for income utilise a modern form of contraception, compared to 44 percent of women who are unemployed. The percentage of women who take modern contraceptives rises with income, from 36% of those in the lowest quintile to 53% of those in the highest.

According to the 2011 census, India had 1,210,854,977 people living there. Since 2001, India's population has grown by 181.5 million, somewhat less than Brazil's population. With 2.4 per cent of the world's landmass, India is home to 17.5% of its inhabitants. India's population is increasing at a decelerated rate of 17.7 per cent. The overall literacy rate grew to 74.04%, with 82.14% of men and 65.46% of women being literate (Census, 2011).This much population creates burden on the economic growth and development and reduces per capita availability of land, wealth and other resources. Population beyond a limit create problem for the mother health, family, society and economy as a whole such as; lack of food, housing and other basic necessities. Its create burden on economic growth and development of the economy. So it is necessary to study the factors which affect the TFR and suggest policy for family planning to stabilize the population growth. Objective of this study is to examine the factors that affect fertility rate to determine which factor is most important in recommending successful policies to raise public knowledge of family planning.

There are five sections in this paper. The introduction is contained in the first section. A review of the literature and the identification of variables constitute the second section. The third portion covers methodology and data sources. The fourth section discusses the results of the regression and the study's conclusion is in the fifth section.

Literature review

The total fertility rate is the proportion of births to average number of women of childbearing age in a particular year. Total fertility rates are calculated using a range of ages from 15 to 49. However, a small but growing number of women are becoming pregnant at 50 and older as a result of recent advancements in fertility-enhancing medicines (D'Addio, & d'Ercole, 2005).Recent TFRs by race and Hispanic origin at the state level are provided in this publication, which may shed light on demographic changes in the US. The TFR calculation makes the assumption that women will continue to give birth at the same age-specific rates throughout their reproductive lives. The TFR is therefore a projection of their potential completed fertility. However, the actual age-specific birth rates that women will experience during their childbearing ages will determine the final completed fertility of women (Mathews, & Hamilton, 2019).The most frequently accepted and utilised indicator of current fertility is the total fertility rate (TFR). Given that TFR is based on age-specific fertility rates, it is necessary to know both the total number of births across all age groups and the age of the mother. The information on age may have some recall bias, misreporting digit preference, etc. when the population is older or illiterate. In this case, the TFR may deviate from the real age. In this study, an effort has been made to pinpoint specific predictors that help explain TFR and to offer suggestions for the best predictor combinations to use when estimating TFR. The regression technique is the basis of the methodology used in this research (Tiwari et al., 2020).

The TFR for every country will be projected using a Bayesian projection model. The three phases of the fertility transition, pre-transition high fertility, and post-transition low fertility are how the model breaks down the evolution of TFR. This makes the assumption that eventually fertility will decline below replacement level. Two logistic functions that depend on the current TFR level are added together with a random term to represent the fall in TFR. Future TFR is projected using a Bayesian hierarchical model based on both the country's historical TFR and the global pattern. An autoregressive model is used to simulate the low fertility phase following the shift. Out-of-sample projections for the time periods since 1980 and 1995 are used to evaluate the approach (Alkema et al., 2011).

The correlations between total fertility rate, women's educational attainment, and labour force participation using data from multiple countries. The findings are presented in this

report. 71 countries' total data were compiled from a variety of sources. Multivariate linear regression analyses are used to examine eight variables related to women's fertility, mortality, economic status, labour force participation, and education. The total fertility rate is regressed on these variables. The data is better captured by women's educational attainment and labour force involvement than by the smaller model. The full model predicts that while the average number of years of schooling for women is indirectly associated to total fertility rate, the proportion of women in the labour force is directly related to total fertility rate (McClamroch, 1996).

Programs for population stability in India may benefit from district level factors affecting the overall fertility rate in the Empowered Action Group states of India. In this study, the overall fertility rate among districts in the Indian Empowered Action Group states will be predicted using district-level factors. MLRM were created and assessed with the help of the Akaike Information Criterion. Recursive partitioning was utilised to create a regression tree that could be understood better. Illiteracy among married women was positively correlated with the overall fertility rate and accounted for more than half (53%) of the variation. Married illiteracy, infant mortality rate, Antenatal care registration, household size, median age of live birth, and sex ratio explained 70% of the variance in total fertility rate under the MLRM estimates (Kumar et al., 2017).

Methodology

The secondary data is used to full fill the objective of the study. The data was collected from two different sources. Data on Per Capita Net State Domestic Product (PCNSDP) for different states are collected from RBI publications for the year 2019-20. We have transformed the PCNSDP series into the Log series (LPCNSDP) to make comparable with other variables because PCNSDP is comparatively big numbers. Cross section data on Total fertility rate (TFR), male literacy rate (MLIT), Women literacy rate (WLIT), Infant mortality rate (IMR), Anny method for pregnancy prevention (contraceptives, etc.) and working women in last 12 months (working_women12) are collected from the NFHS – 4 fact sheet. In this study we have collected information for 28 Indian states and one union territory Delhi. PCNSDP data for Jammu and Kashmir is not well defined in this particular year. The NFHS considered as a reliable and important source for health related indicators. Information on significant trends and indicators for India and its states is provided in this fact sheet. 14 Field Agencies carried out the NFHS-4 fieldwork in India from 20 January 2015 to 4 December 2016, collecting data from 601,509 households, 699,686 women, and 112,122 men.

According to the objective of the study, TFR is a dependent variable, and IMR, PCNSDP, any method, MLIT, WLIT and working_women12 are an explanatory variable. The study uses a Multiple Linear Regression Model (MLRM) to analyse the data with the help of the E-views 10 software package. The Ordinary Least Square (OLS) technique is applied for regression. Regression is one of the tools used for data analysis. Its focus is on analysing and characterising the causal and functional relationship between variables. The link between the variables is expressed using an equation or model. The computed coefficients demonstrate how a change in one unit of the explanatory variable affects the dependent variable (Greene, 2003).

We must define our MLRM as follows:

$$TFR_i = \alpha + \beta_1 LPCNSDP_i + \beta_2 \text{ any method}_i + \beta_3 WLIT_i + \beta_4 MLIT_i + \beta_5 IMR_i + \beta_6 Working\_women12_i + u_i \quad \ldots\ldots(1)$$

Here, TFR is dependent variable and PCNSDP, any method, WLIT, MLIT, IMR and working_women12 are explanatory variables. The α is the intercept and β_1, β_2, β_3, β_4, β_5 and β_6 are coefficients of explanatory variables respectively. The u_i is disturbance term.

To examine the factors that affect TFR. In order to achieve the goal, we first verified all of the key tools of the equation, such as the R-squared goodness of fit metrics of the estimated regression model of data. It ought to be between 0 and 1. When the value is close to 0, the explanatory variables have not contributed significantly to the understanding of the variation in the dependent variable; however, when the value is close to 1 or higher, the estimated equation has a good fit

and contributes significantly to the understanding of the dependent variable. When an estimated coefficient is statistically significant, the null hypothesis is rejected; conversely, when it is statistically insignificant, the null hypothesis is accepted. The estimated model's regression's overall significance is examined using the F-test. Statistical significance for the F-test is taken into account up to a 5 per cent level. The estimated F is statistically significant when p-value >0.05 (Bhaumik, 2015).

This study used cross-section data set, so after estimating the MLRM, it is necessary to check problem of Multicollinearity and Hetroskedasticity. To check the problem of Hetroskedasticity the Breusch-Pagan-Godfrey test is performed. Heteroskedasticity causes OLS estimators inefficient. The standard error from OLS regression becomes underestimates under presence of hetroskedasticity. We have to apply heteroskedasticity consistent standard errors to correct the result. However, the OLS estimators continue to remain unbiased, and consistent under heteroskedasticity (Bhaumik, 2015).For the problem of Multicollinearity the Variance Inflation Factors (VIF) test is performed. It makes OLS result imprecise or unreliable. The VIF value greater than 10 means serious multicollinearity. The centred VIF between 3-10 means negligible presence of multicollinearity and below 3 means absence of the problem of multicollinearity.

Result and discussion

To examine the factors associated with TFR in India, we have run the MLRM regression of any method, LPCNSDP, IMR, WLIT, MLIT and working women12 on TFR. On the basis of exiting literature, we have hypothesize that the TFR is negatively related with any method utilised for pregnancy prevention, LPCNSDP, WLIT, MLIT, working women12 and positively related with IMR. In order to examine the validity of these hypotheses we have estimate the MLRM using OLS technique. Result is shown in the table 1.

Table 1: OLS estimates of TFR

Variable	Coefficients	t-statistics	P-value
C	8.235478	6.212459	0.0000
ANY_METHOD	-0.014418	-4.565007	0.0002
LPCNSDP	-0.465226	-4.251124	0.0003
IMR	0.007652	1.694246	0.1043
WLIT	0.002033	0.651060	0.5218
MLIT	-0.004730	-0.472855	0.6410
WORKING_WOMEN12	-0.001301	-0.262443	0.7954
Dependent variable - TFR		Included observations: 29	
R-squared 0.830364Adjusted R-squared 0.784100F-statistic 17.94826Prob(F-statistic) 0.000000			

Source: Author's calculation obtained from secondary data

Each estimated coefficients in the above table represents the partial effect of change in its associated explanatory variable on the dependent variable. It is clear from the above result the one point change in the LPCNSDP would change TFR by nearly 0.4652 point. Among these entire six explanatory variables the marginal effect of LPCNSDP is highest on TFR followed by any method, IMR, MLIT, WLIT and working women12. Only any method and LPCNSDP are statistically significant (p-value 0.0002 and 0.0003 respectively) at 1 per cent level and have expected sign as per our hypotheses. WLIT have not expected sign (0.002033) and it is statistically insignificant (p-value 0.5218). IMR has expected sign but it is statistically insignificant (p-value 0.1043). MLIT and working women12 have expected negative association but both the factors are also statistically insignificant. The value of R^2 for the estimated model is 0.830364 which implies that these six explanatory variables together explained nearly 83 per cent total variation in the TFR. The compute value of R^2 is statistically significant which is explained by

computed-*F* statistics. The *F* statistics (17.94826) is statistically significant (p-value 0.00000) at 1 per cent level which implies the overall estimated model is significant.

Hetroskedasticity test is compulsory in the context of cross-section analysis. In this study to perform the test of heteroskedasticity in the context of our estimated model, we have applied the Bruesh-Pagan-Godfrey test. This test provides computed value of *F* and *LM* statistics. Value are 0.703637 (p-value 0.6499) and 4.669122 (p-value0.5869) respectively. Since the both the statistics are statistically insignificant so, we accept the null hypotheses of homoeskedasticity and conclude that the estimates are free from the problem of hetroskedasticity.

Table 2: Multicollinierity test

Variable	Centered VIF
ANY_METHOD	1.293675
LPCNSDP	2.210862
IMR	1.811734
WLIT	1.629329
MLIT	1.920231
WORKING_WOMEN12	1.045697

Source: Author's calculation obtained from secondary data

The presence of multicollinearity in the data provides the biased estimates. To detect the multicollinearity Variance Inflation Factor (VIF) test is performed. It is shown in the table 2; the value of centred VIF for all the explanatory variables is less than 3. We conclude that there is no evidence of multicolinearity in the context of out estimated regression model. Now we can conclude that the estimated model is unbiased on the basis of these tests of multicollinearity and hetroskedasticity.

Table 3: OLS result for only significant variables

Variable	Coefficients	t-statistics	P-value
C	9.353718	10.87271	0.0000
ANY_METHOD	-0.013532	-4.676051	0.0001
LPCNSDP	-0.569639	-7.426739	0.0000
Dependent variable - TFR		Included observations: 29	
R-squared 0.797180		Adjusted R-squared 0.781578	
F-statistic 51.09625		Prob(F-statistic) 0.000000	

Source: Author's calculation obtained from secondary data

In the table 1 we have seen that, only two explanatory variables are significant. These two significant factors are any method and LPCNSDP. Now we run the separate regression of any method and LPCNSDP on TFR to see the value of estimated coefficients and significance of the model (R-square and *F* statistics) separately. Result is presented in the table 3. The value of estimated coefficients for both the explanatory variables are enhanced (-0.013 and -0.5696 respectively) both have expected negative sign as hypothesized and both are statistically significant at 1 per cent level. The value of R^2 is decreased (0.83 to 0.79) may be due to exclusion of insignificant variables. The value of Adjusted R-square is remaining same (0.78). The value of computed-*F* statistics has improved and p-value of F statistics is 0.0000.

Conclusion

In this study we have taken 28 states and one union territory Delhi total 29 states for the study. Among these 29 states 18 states have below or up to replacement level of TFR. Only 11 states have above replacement level TFR. Bihar and Meghalaya have highest TFR in India (3.4 and 3 respectively). Bihar state has low per capita income, low utilisation of any method for pregnancy prevention, low literacy rate and low working women for cash income so people are not aware about cost of extra child bearing in Bihar. The TFR and PCNSDP state wise are shown in the appendix (Figure 1& 2). Sikkim has 1.2 TFR, as expected here

per capita income, literacy rate, is high and people are aware about utilisation of method for pregnancy prevention. Followed by Kerala, Punjab and Goa (TFR 1.6, 1.6 and 1.7 respectively), these states have high per capita income, and literacy rate.

All in all the result made us to conclude that the per capita income followed by any method (contraceptives, etc.) are major factor which affect the TFR in India. Bothe the variable are negatively related with the TFR. So policies which improve income of the people and increase awareness about utilisation of pregnancy preventive method in the state where TFR is higher helps the nation in family planning and population stabilisation.

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Appendix

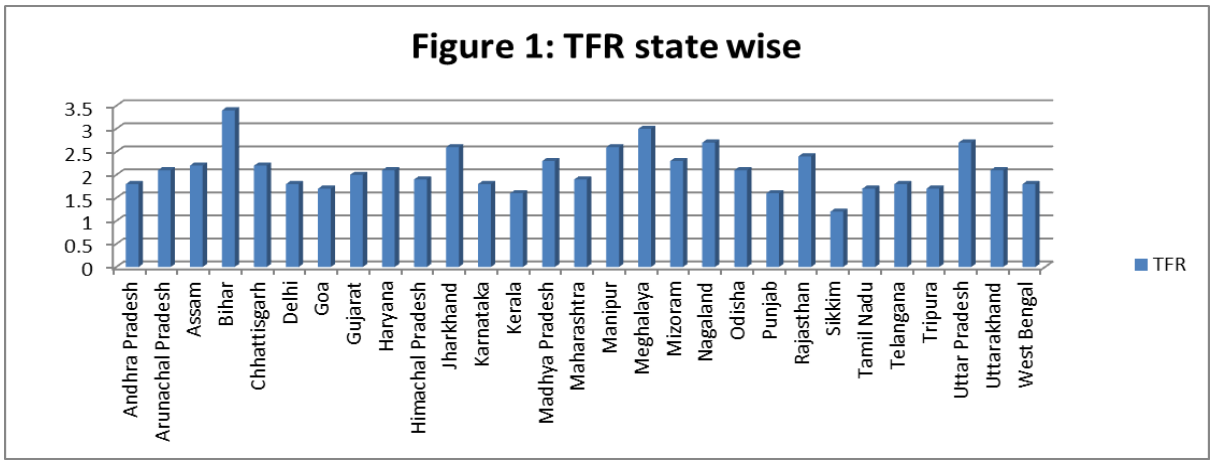
Figure 1: TFR state wise
3.5
3
2.5
2
1.5
1
0.5
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Chhattisgarh
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarakhand
West Bengal
TFR

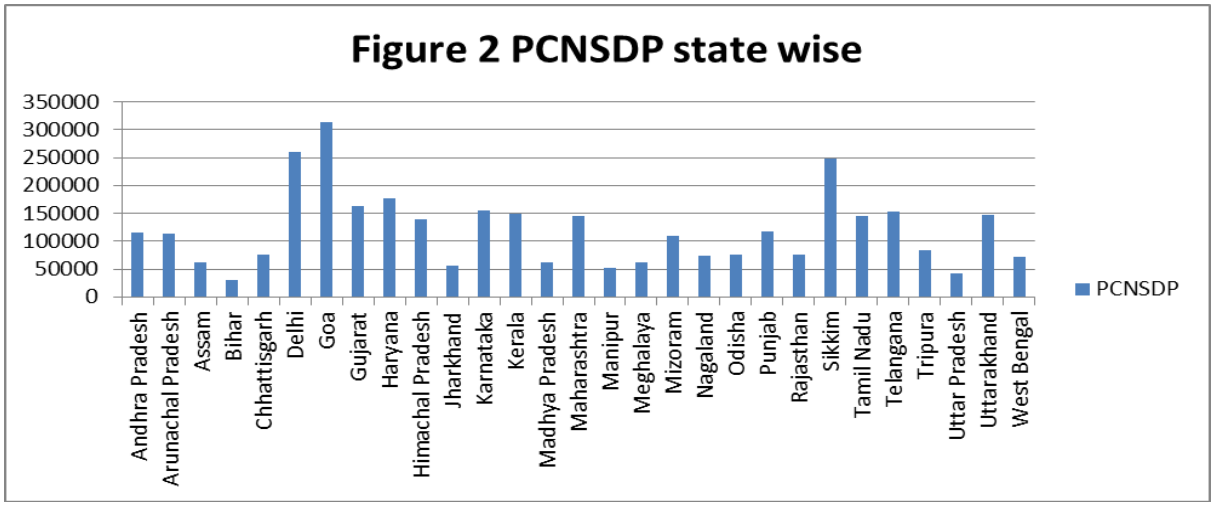
Figure 2 PCNSDP state wise
350000
300000
250000
200000
150000
100000
50000
0
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Chhattisgarh
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Punjab
Rajasthan
Sikkim
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarakhand
West Bengal
PCNSDP

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