



# Determinants of fertility differentials: A cross-country analysis

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**Abstract**

Total fertility rate in lower income countries and in lower middle income countries is atleast triple as high as in upper middle income countries and in higher income countries. The main objective of the study is to inquire the relationship between the fertility rate differentials or the (TFR) total fertility rate which is taken as dependent variable and the various independent variables as infant mortality rate(IMR),female life expectancy, female labour force ,gross domestic product, and female employment. In this study it has been tried to find out that which of the following factors are more significant in affecting fertility rate differentials. The sample of the study takes total 8 countries from all over the world. The countries have been divided in four groups as per income ,in each group 2 countries have been taken. In lower income group Ethiopia and Sudan have been taken ; in lower middle income group India and Bangladesh; in upper middle income group Indonesia and China and in higher income United kingdom and Australia have been taken.The statistical methods used in the study are Descriptive analysis,coefficient correlation and multiple regression analysis and tried found out that the factors like female life expectancy and female labour force are having significant relationship with the dependent variable TFR.

**KEYWORDS-**Fertility differentials, life expectancy, infant mortality rate, female employment, gross domestic product.

## Introduction

Fertility differential or differential fertility consist of the group differences which can be associated with different anonymous factors as nativity, colour

residence ,socio-economic characteristics or various other psychological characteristics.

Cross -country fertility differentials are significant according to the wide amount of data on various factors as per ‘World Bank Database ‘ and these differences tend to diminish as the country becomes more developed .

According to the world Bank country classification by income level which is carried out every year on July 1 ,known as “Atlas method of calculation”, the World economies are categorised into 4 income groups -

- 1.)Low income countries
- 2.)Lower-middle income countries
- 3.)Upper middle income countries
- 4.)High income countries

This study takes 2 countries in each group for finding out cross country fertility differentials .In low income country -Ethiopia and Sudan ,In lower-middle – India and Bangladesh ,In Upper-middle – China ,Indonesia and In high income -United Kingdom and Australia have been taken.

Before turning to this cross country analysis lets take a birds eye view on **various theories** or earlier approaches to fertility which emerged with the birth of political arithmetic in England during 17-18<sup>th</sup> century where religion was blamed for the decline of European population (by **William Petty ,1683**), while **John Grount** (1662) using statistics from city of London ,had shown that more than 100 boys born per 100 girls which was open to debate since then many efforts were made but the theories were either not having full-fledged explanation or they were rejected, there ideas have sparked so much debate and country .Our overview inevitably begins with **Malthus** the most famous contributor and author of ‘**An Essay on the Principles of population** ‘ published in 1798, (fifth Edition) , concerned with the relationship between population growth and resources propounded that population growth will always tend to outrun the food supply as population grows in a (geometric progression) and food supply grows in an(arithmetic progression) and talked about various artificial and natural checks.

One of the most implacable adversaries of Malthus was **Karl Marx** who propounded that birth control cannot be justified on

the basis of an economic imperative although his view point was thrashed out at length but without much progress.

### ➤ Policies:

Among the 201 countries , it had been estimated that 83 of the countries are having low fertility ,as women in these countries bear fewer than 2.1 children over a lifetime, 96 of the countries had intermediate levels of fertility where women are bearing between 2.1 and 5 children while 22 of the countries have high levels of fertility with women bearing more than 5 children.

So, the governmental policies are also implemented accordingly ,if we talk about globally or at world level ,then 42% of the government have adopted the policies to reduce current levels of fertility – as raising the minimum legal age at marriage , including low cost ,safe and effective contraception ,improving female education and providing employment opportunities .

In our analysis we have taken ,8 countries as per world bank classification of countries in 4 groups as per income level, 2 countries from each group .

Long period time series data have generally shown an inverse relationship between income and fertility which means as the countries move towards higher income level, fertility declines as compared to the countries having lower level of income.

The fertility rate among the less developed countries (LDC'S) is atleast triple as high as among the more developed countries (MDC'S) as in the lower income countries like Ethiopia and Sudan, fertility rate is approximately 7 which remains constant till 1995 and after that there is steep decline. If we talk about of lower middle income countries India and Bangladesh, fertility rates were a little less from lower income countries i.e.,5.9 and it has also declined and now reached the rate of 2.2in 2019. Now when we move towards upper middle income countries Indonesia and China where initially TFR was approximately 5, later on in 2019 due to" ONE CHILD POLICY" of China, TFR has come down to 1.1,however the policy ended in 2016. Now when we talk about high income countries, where TFR was below replacement level of fertility, TFR was maintained between 2 to 1 per woman.

## **LITERATURE REVIEW**

Fertility differential has not only been a crucial topic for one or the other country or within country but it has an international relevance and so the cross-

country fertility differentials also explain wide differences among females of different countries. Although in lower income countries, total fertility rate(TFR) declined somewhat, but still remains high owing to some significant factors as lack of education, early marriages, unawareness of contraceptives etc. but higher income countries have lower TFR. The women of lower income countries used to have their first child at age 19 and last child at age 37 as compared to the higher income countries where women used to have their first child at age 30 and last child at age 37. (United Nations 1995).

In lower income countries , good health and family planning services and good health are very crucial for women as well as children . If IMR(Infant mortality rate ) is lower ,this means that the women can reach their desired family size with fewer pregnancies. The relationship between IMR and TFR is positive and the replacement level may be greater or lesser than the expected loss of children . (Shullz,1976).

Infant mortality can affect fertility through either a biological or a behavioural mechanism . The biological effect relates to the fact that women with early death will naturally resume ovulation earlier than women with surviving breastfed children (Van Ginneken,1974).The behavioural effect regards that couples with high infant mortality will seek to have additional children either to replace those that are lost, or as insurance against perceived potential losses(Preston,1975).

The participation of females in the labour force is negatively related to fertility rate for many reasons . Female employment outside the home is related to forming small families, working women tend to have fewer children than those who do not work because employment entails alternative satisfaction to the children(Blake,1979).

The World Fertility Survey suggests that the declines in infant mortality and fertility among the population of Latin American countries that have been the last to become the part of demographic transition ,conclude that future decreases in infant mortality , which is still high in Latin American Countries could consequently leads to fertility declines(Chackiel and Schkolnik,1997).

In Sub-Saharan Africa , the findings from the Demographic and Health Surveys shows that desired family size decreased significantly. Two-third of the countries examined show evidence of fertility decline, particularly in Kenya and Zimbabwe. Countries where education for women was higher and child



mortality was lower experienced larger reductions of fertility. Use of contraceptives was practiced for birth spacing and that contraceptives method has gained wide acceptance among younger cohorts(Dudley Kirk,Bernard Pillet(1998).

Women's life expectancy increased between 1970 and 1990 in every country. The increased for women averaged 8-9 years in higher income countries and four years in lower income countries. In higher income countries women can expect to live 75 years or more ,while in lower income countries ,life expectancy is 45 years practically in Africa and Western Asia (United Nations,1995)

## **OBJECTIVES**

- 1.To find out the fertility differentials among the selected countries by dividing them into various income groups.
- 2.To do the comparative analysis of the Total Fertility Rate of the various countries by using descriptive analysis.
- 3.To find out the degree of association between the various selected independent variables and the dependent variable TFR for the different selected countries on the basis of various income groups.
- 4.To do the multiple linear regression analysis and to find out the percent of variance explained by the set of independent variables on the dependent variable.

## **RESEARCH PROBLEM**

The study of fertility differentials has become very crucial in the present era for the different countries as we know that the demographic dividend of the countries specially of the higher income countries is lower and of rest of the countries also it is not very satisfactory while for the development of any country we need a strong demographic dividend so that the countries can prosper at a higher rate ,therefore in this study it has been tried out to find the fertility differences by considering different independent variables and dependent variables on various income groups of countries as the

analysis of fertility differences and income inequality is more realistic and if the fertility differences increase with inequality, countries where inequality is higher will accumulate less human capital and will grow slower.

## Methods

- **Data and Sample**- The various sources of data of different countries include World Bank Open Data from THE WORLD BANK from where all data of selected variables were collected for 29 years (from 1991 to 2019).
- **Sample:-** In the sample 8 countries from all over the world are selected on the basis of World Bank classification of countries by income level. So, the 2 countries from each of the 4 income groups are chosen for the sample in which Sudan and Ethiopia are lower income countries India and Bangladesh are lower middle-income countries. Indonesia and China are upper middle countries, and United Kingdom and Australia are higher income countries.
- **Definition and Measurement of Variables**- The following is the description of the various variables selected for the study along with their meanings:-
  1. **The Dependent variable** – In the paper, Total Fertility Rate (TFR) is taken as dependent variable which is defined as the “average number of children that would be born to a woman over her lifetime, if she were to experience the exact current age – specific fertility rates through her lifetime she was to live from birth until the end of her reproductive life.
  2. **Independent Variable:**
    - I. Infant Mortality Rate – is defined as the probability of deaths of children under one year of age per 1000 live births.
    - II. Female Life Expectancy – is defined as the number of years than a female is expected to live as determined by statistics.
    - III. Female Labour Force – as a percentage of the total, shows the extent to which women are active in the labour force.

- IV. Gross Domestic Product-is the total value of goods produced and services provided in a country during one year.
- V. Female Employment – is any work for pay or profit in which women are engaged .

- **Statistical Methods** – 3 methods are used for the analysis of data –
- I. **Descriptive Analysis** – where the average of the total fertility rate which is the mean of the dependent variable is used to compare the TFR's of the various countries of 4 income groups .
  - II. **Correlation Co – efficient-** which determines the relationship between dependent and independent variables.
  - III. **Multiple Regression Analysis** – is a statistical technique which is used to analyse the relationship between a single dependent variable and several independent variables.

## Results

1. **Results Of Descriptive Analysis** – Mean of the dependent variable which is used as a descriptive measure of different countries is presented in the Table 1 .Here , it has been found out that the highest mean of the TFR is of lower income group countries where Ethiopia 's mean is ( 5.78) and of Sudan is 5.18 while at the second place , lower middle income countries are there in which India has (2.97 ) mean and Bangladesh has (2.85) after that upper middle income countries are there where mean of Indonesia is (2.53) . Higher income countries are having lowest mean where Australia has (1.82) and UK has (1.76) mean .Among all the countries the lowest or the smallest mean is of China (1.67) which is an upper middle-income country .

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**TABLE 1.**

TFR (mean of different countries)			
			Mean
Lower income countries			
1.Ethiopia			5.78
2.Sudan			5.18
Lower middle income countries			
1.India			2.97
2.Bangladesh			2.85
Upper middle income countries			
1.Indonesia			2.53
2.China			1.67
Higher income countries			
1.United Kingdom			1.76
2.Australia			1.82

The population replacement rate , needed to maintain a society 's population size is 2.1 children per woman .

In this paper , lower income countries have high fertility rates which means that countries may suffer from various health risks and other economic and environmental threats while the lower middle and upper middle countries have tried to maintain the replacement level .When we talk about high countries this level is lower than maintained rate which means countries are experiencing older demographic dividend .

**2. Result Of Correlation Coefficient :-** The results are shown in the following table – which shows the correlation among Total Fertility rate as dependent variable and Infant mortality Rate , Female life expectancy , female labour force ,female employment and Gross Domestic Product as independent variables.

- **Correlation Coefficient of :-**

- a) **Lower Income Group countries :-**

- 1.**Ethiopia** – This is the country which reveals a statistically significant negative relationship between 2 variables.

- a. TFR and female labour force ,  $r = -0.228$ ,  $p < 0.05$

- b. TFR and female life expectancy  $r = -0.184$ ,  $p < 0.05$  while the other 2 variables are having statistically significant negative association with TFR i.e. .

- a. IMR ( infant Mortality Rate  $r = -0.014$ ,  $p < 0.2$  ( 20% significance level )



b. Employment  $r = -1.313$  ;  $p < 0.2$ .

**2.Sudan** – Sudan is a lower income group country which shows a statistically significant positive association between TFR and employment  $r = 0.155$ ,  $p < 0.5$  and statistically significant negative association between TFR and Life Expectancy  $r = -0.147$ ,  $p < 0.05$ , while there is a statistically significant positive association between TFR and IMR  $r = 0.008$ ,  $p < 0.2$  and statistically significant negative association between TFR and female labour force  $r = -0.014$ ,  $p < 0.2$ .

**TABLE 2.1**

Correlation coefficients of lower income group countries					
INDEPENDENT VARIABLES			DEPENDENT VARIABLE(TOTAL FERTILITY RATE)		
			ETHIOPIA	SUDAN	
1. Infant Mortality Rate			-0.014 **	0.008 **	
2. Female Life Expectancy			-0.184 *	-0.147 *	
3. Female labor Force			-0.228 *	-0.014 **	
4. Female employment			-1.313 **	0.155 *	
5. Gross Domestic Product(GDP)			0.003	-0.001	
**= $p < 0.2$			*= $p < 0.05$		

**b) Lower middle income group countries –**

- 1. India** – This country reveals a statistically significant negative association between TFR and IMR, Life Expectancy, Labour force and Employment at 5 % level of significance. IMR  $r = -0.044$ ,  $p < 0.05$ ; Life expectancy  $r = -0.384$ ,  $p < 0.05$ , labour force  $r = -0.021$ ,  $p < 0.05$ , employment,  $r = -0.352$ ,  $p < 0.05$ .
- 2. Bangladesh** – In this country, statistically significant positive association is shown between TFR and IMR  $r = 0.019$ ,  $p < 0.2$ ; and TFR and employment  $r = 0.303$ ,  $p < 0.2$ .

**TABLE 2.2**

Correlation coefficients of lower middle income group countries						
INDEPENDENT VARIABLES			DEPENDENT VARIABLE(TOTAL FERTILITY RATE)			
			INDIA		BANGLADESH	
1.Infant Mortality Rate			-0.044 *		0.019 **	
2.Female Life Expectancy			-0.384 *		-0.064	
3.Female labor Force			-0.021 *		-0.001	
4.Female employment			-0.352 *		0.303 **	
5.Gross Domestic Product(GDP)			0.001		-0.007	
			**=p<0.2		*=p<0.05	

### c) Upper Middle Income Group Countries –

**1.Indonesia** – This country reveals statistically significant positive association between TFR and IMR  $r = 0.038$ ,  $p < 0.05$ ; and TFR and life expectancy,  $r = 0.101$ ,  $p < 0.05$  and statistically significant negative association between TFR and female labour force  $r = -0.039$ ,  $p < 0.05$

**2.China** – in this country, variables like IMR, Life expectancy, Female labour force and gross domestic product shows statistically significant negative association with TFR.

- I. IMR,  $r = -0.035$ ,  $p < 0.05$
- II. Life expectancy  $r = -0.446$   $p < 0.05$
- III. Labour force  $r = -0.202$   $p < 0.05$
- IV. GDP  $r = -0.016$   $p < 0.05$

While statistically significant positive association is shown between TFR and Employment  $r = 3.045$ ,  $p < 0.05$

**TABLE 2.3**

Correlation coefficients of upper middle income group countries						
INDEPENDENT VARIABLES			DEPENDENT VARIABLE(TOTAL FERTILITY RATE)			
			INDONESIA		CHINA	
1.Infant Mortality Rate			0.038 *		-0.035 *	
2.Female Life Expectancy			0.101 *		-0.446 *	
3.Female labor Force			-0.039 *		-0.202 *	
4.Female employment			-0.008		3.045 *	
5.Gross Domestic Product(GDP)			0.002		-0.016 *	
				*=p<0.05		

#### d) Higher Income group Countries –

1. United Kingdom – This country reveals statistically significant positive association between TFR and life expectancy  $r=0.120, p<0.05$  while statistically significant negative association between TFR and labour force  $r=-0.169, p<0.05$ .
2. Australia -In this country , also the relationship between TFR and female life expectancy is statistically significant positive  $r=0.243, p<0.05$  while statistically significant negative association between TFR and female labour force  $r=-0.223, p < 0.05$ .

**TABLE 2.4**

Correlation coefficients of higher income group countries				
INDEPENDENT VARIABLES		DEPENDENT VARIABLE(TOTAL FERTILITY RATE)		
		UK	AUSTRALIA	
1. Infant Mortality Rate		0.001	0.041	
2. Female Life Expectancy		0.12 *	0.243 *	
3. Female labor Force		-0.169 *	-0.223 *	
4. Female employment		-0.072	-0.025	
5. Gross Domestic Product(GDP)		-0.009	0.001	
		*=p<0.05		

### 3. Results of Multiple regression :

- Lower Income Countries** – The  $R^2$  of Ethiopia and Sudan is 0.998 which means that set of independence variables explain 99.7 and 99.8 percent of the variance in total fertility rate while adjusted  $R^2$  was 0.996 and 0.996 for Ethiopia and Sudan .
- Lower middle-income countries** – The  $R^2$  of India and Bangladesh is 0.998 and 0.999 which means independent variables explain 99.8 and 99.9% of variance in TFR and their adjusted  $R^2$  is 0.998 and 0.999.
- Upper middle-income countries**- The  $R^2$  of Indonesia and China is 0.935 and 0.962 meaning independent variables explained 93.5 and 96.2 percent of variance in TFR while their adjusted  $R^2$  is 0.922 and 0.953.
- Higher income countries**-The  $R^2$  of UK and Australia is 0.647 and 0.510 which means set of independent variables explains 64.7 and 51.0 percent of variance in TFR and their adjusted  $R^2$  is 0.57 and 0.404.

**TABLE 3**

Multiple regression of different countries				
			R-Squared	Adjusted R-Squared
Lower income countries				
1.Ethiopia			0.997	0.996
2.Sudan			0.998	0.998
Lower middle income countries				
1.India			0.998	0.998
2.Bangladesh			0.999	0.999
Upper middle income countries				
1.Indonesia			0.935	0.922
2.China			0.962	0.953
Higher income countries				
1.United Kingdom			0.647	0.57
2.Australia			0.51	0.404

## **CONCLUSION AND DISCUSSION**

Cross country fertility differentials therefore can be seen in different countries where some or the other factors are at the bottom of fertility differentials. Despite of various government policies in every country for health, education, employment, wide differentials can be seen.

When we talk about lower income countries like Ethiopia and Sudan, total fertility rate is very high because of many factors like female participation in labour force , life expectancy , employment which are causing continuous increase in TFR of these countries .

Government of these countries should focus more on the proper sanitation and health facilities' and should enhance the programs for the encouragement of women to participate in labour force, generate more employment opportunities for women .

Next if we talk about lower middle-income countries, like India and Bangladesh where the factors like life expectancy of females, labour force are causing increasing TFR.

Efforts should be made to increase female's life expectancy, encourage women for education ,training and self-development, create awareness so that total fertility rate can be reduced and countries can prosper by providing antenatal care to 100% of pregnant women.

Coming to upper middle-income countries like Indonesia and China, where China needs to increase female labour force ,life expectancy, employment, GDP



for lowering TFR and Indonesia needs to increase female labour force while lower infant mortality rate to decrease total fertility rate.

When we talk about higher income countries; here TFR is below replacement level i.e., 2.1, therefore they need to increase TFR.

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