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Fertility, Mortality and Inequality

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Abstract: Present paper discovers the behaviour of fertility differentials across districts of Punjab, Pakistan. Social researchers agree that development and quality of life of the people are associated with distribution of economic resources. The objective is to investigate some salient determinants of fertility differential through distribution of income. Data used in this study is gathered from Multiple Indicator Cluster Survey 2013-14. Both parametric and non-parametric analysis is done. Regression analysis is used to investigate the relationship of fertility determinants. For empirical analysis, Total Fertility Rate is taken as an outcome variable while distribution of income, unemployment rate, under-five mortality and contraceptive use are considered as determinants. The outcome of this study is that distribution of income is a very significant variable in determining the level of fertility so inequality might be reduced to overcome the issue of high fertility rates at the district level of Punjab. Contraceptive use is also a very effective variable in determining the level of fertility. It is found that child mortality has a positive relationship with fertility rates. Unemployment rate is a very useful variable for the determination of fertility level.

Key words: Fertility, Mortality, Inequality, Regression Analysis, Non-Parametric model
JEL Classification: I12, J13, C14.

1. Introduction

Population studies have a long history in economic literature. Population growth has been observed as a very significant determining factor of economic growth. However, fertility has a very essential title role in defining population growth rate. Fertility differentials matter as it also has an impact on human capital accumulation. Population size and composition basically relied upon factors of mortality, fertility and migration. However, fertility is very fundamental determinant, as it is crucial for continuance of life. Fertility examination is a significant consideration for policy making

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to take guideline for family planning. Differential fertility is an essential aspect of demographic studies. Numerous studies have conducted for exploring causes of various differentials in fertility.

1.1. Situation of Total Fertility in Pakistan

Since the inception of family planning program in Pakistan in 1950s, many governments attempted to check population growth, through increased allocation of resources to family planning activities, the involvement of non-government sector and by adopting multi-dimensional approaches. Democratic governments extended the program to outreach areas by involving field workers for doorstep access to family planning services. Extensive mass media campaigns were launched to create awareness and motivation for contraceptive use. Efforts were also made to integrate health and family planning services. Despite all these efforts and huge investment, population continues to grow at a fast pace. Huge public spending as well as public and private partnership were hardly able to bring down Total Fertility Rate to 4.8 births per women in 2010 [National Institute of Population Studies (NIPS, 2010)].

The population increased from 32.5 million in 1947 to 143.17 million in 2002, 148.72 million in 2004 and 152.53 million in 2005 making Pakistan the 7th populous country in the world (GOP, various issues). In absolute terms, 120 million people have been added to the population during 58 years. Pakistan experienced 6-7 births per women in the early 1990s (Sathar and Zaidi, 2009 & Hakim, 1994). This predicts future demographic momentum for population increase. Every passing minute adds eight new babies to the population and 70 children breathe their last every hour in Pakistan. [UNICEF (2010)]

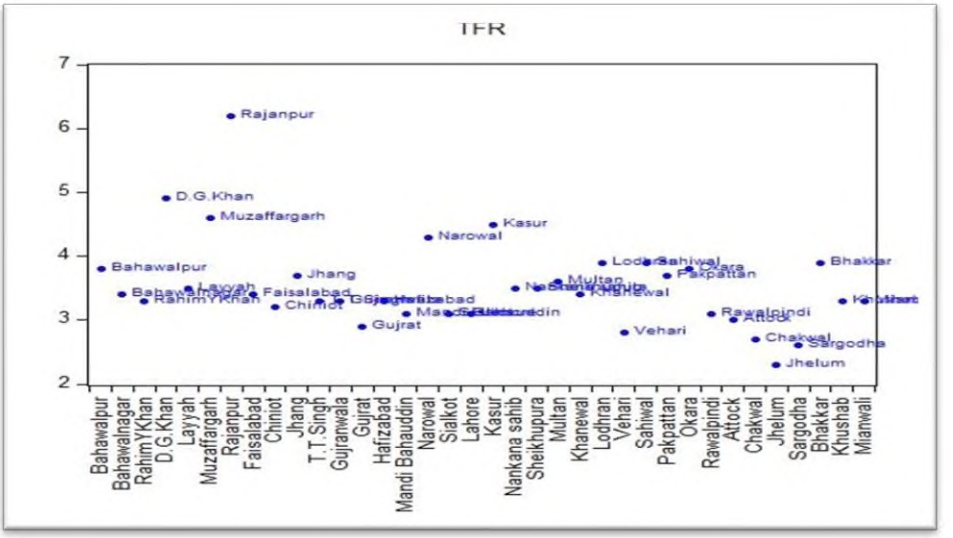
High fertility rate is the main determinant behind the differences among the population growth rates in Pakistan as well as some South Asian countries. Bangladesh total fertility rate is 2.3 percent, Bhutan total fertility rate is 2.6 percent, China's TFR 1.5 percent, India's TFR is 2.4 percent, Nepal's total fertility rate is 2.6 percent, Sri Lanka's total fertility rate is 2.1 percent and Maldives's total fertility rate is 2.3 percent. According to the latest issue of Pakistan Economic Survey, 2014, total fertility rate of Pakistan is 3.2 percent. Total fertility rate (TFR) of the

rural residents is 4.2 percent while in case of urban residents, it is 3.2 percent (PDHS, 2013). Determinants across different districts of Punjab are important to study because population growth in Punjab is higher than other provinces. There are innumerable factors like socioeconomic and demographic determinants that are thought to be accountable for the differentials in fertility of the regions. This paper attempts to highlight some socio-economic and demographic determinants, causing differentials in fertility. Under-five mortality, employment rate and contraceptive use are important determining factor of fertility differentials through the districts of Punjab.

Forty six percent of female population is in reproductive age. Population that is under 20 years comprises more than half of the total population. Similarly, a significant proportion of girls in the Punjab province are married in their teens and also start childbearing in that age. Forty per cent children are born within 24 months of the birth of an older sibling. A large proportion of pregnancies are unintended and unplanned. This puts women's health at greater risk through early childbearing.

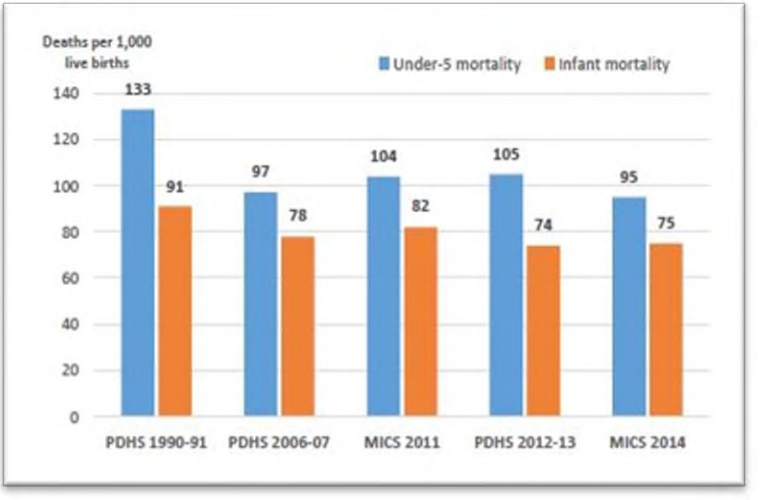
The country comprises of five provinces. The five provinces are Punjab, Sindh, KPK, Gilgit Baltistan and Baluchistan. Punjab is the utmost populated region of Pakistan and accounts almost 56 per cent of the population followed by Sindh. KPK is the third with regard to population and Baluchistan comes in last.

Figure 1: Distribution of Total Fertility Rate among Districts of Punjab Province.



Source: Author's Calculation.

Figure 2: Overtime Variations in Under-5 Mortality & Mortality Rates from 1990-2014.



Source: Multiple Indicator Cluster Survey (MICS).

In Figure 2 the variations in the recent Multiple Indicator Cluster Survey 2014 is compared with MICS 2011 Punjab and Pakistan Demographic and

Health Survey (PDHS) 2012-13. Throughout previous four years the MICS estimations point out a decrease in infant and child mortality.

1.2. Aim of the Study

The present study will explore the fertility trends at districts level in Punjab. Conferring to the 6th population and housing census 2017, population of Pakistan has increased to 207.7 million, showing 57 per cent increase from earlier census in 1998. An average annual population growth rate is 2.4 per cent over a period of 1998-2017. This population increase is a heavy burden on Pakistan economy. It cannot sustain this burden that's why there is a dire need to handle this issue. Birth rates are declining but the pace of decline is slow. In Punjab province, this issue becomes more severe because Punjab is the densely populated province of Pakistan. Punjab's population reached 110.1 million according to census of 2017. There is a need to figure out the reasons and determinants for high population and high fertility rates and to observe the type of relationship between fertility and other socio-economic and demographic determinants. That's why there is a dire need to study the factors behind this persistent high fertility and to factor out the most important determinant. Very little is explored about fertility differentials at district level in Punjab, Pakistan.

1.3. Objectives of Study

- To rank the districts on the basis of total fertility rate and income inequality.
- To discover the influence of income inequality on fertility differential for districts of Punjab.
- To provide policy implications.

2. Review of Literature

Various socioeconomic and demographic researchers examined significance of differentials of fertility through time and regions. Previous research explored influence of various channels of female status i.e., female educational level and labour force participation on fertility is examined. In this research, labour force participation, under-five mortality

rate and contraceptive usage are analysed to find out the differentials in fertility across districts of Punjab, Pakistan.

Economic development has always been linked with variables of population growth though population appeared as an exogenous variables in some models. The classical demographic transition theory reexamined by Coale Hoover (1958) and Hirschmans (1958), all showed that there existed causal linkages between these two sets of interacting variables. Similarly, in Leibenstains' model of economic development (Leibenstain 1954), population appeared as an integrated endogenous variable. Nelson's model built around three basic variables (Nelson, 1956) i.e., income investment and population growth showed how low income countries of the world are caught up in vicious low income equilibrium trap, where improvement in income per head can only be sustained if rate of capital formation can outgrow population growth.

Population growth itself depends on many interacting variables. Fertility and mortality rates being fundamental as out migration does not tend to fluctuate population growth rates significantly beyond distorting the age-sex composition of the native population. From these two variables, fertility rates are more complex in nature being the resultant of a series of economic, social and cultural factors. It is possible (though quite difficult to maintain) to bring about reductions in mortality rates by means of massive epidemic eradication and other public health programs but this is not so in the case of fertility rates. Economic development itself exerts influence on many variables of fertility for example it brings about higher income, improve literacy rates, urbanization, higher female participation rates in the labor forces. Also with economic development, reorganization of the family structure takes place. Children no longer remain economic assets as in a primitive agrarian society but become economic liability in the changing industrial economy which require higher specialized labor requiring long period of training and investment in human capital. All these factors pulling themselves in the same direction tend to lower fertility rates eventually. (Chaudhary, 1976)

A number of studies conducted in India also indicated that high formal female educational level was related with low fertility. A study

(Chandrasekharan, 1954) revealed that completed size of the family for unbroken marriages up to the age of 45 was six or higher for illiterate, primary school and middle school women in Banglore. It was five for females having higher educational level and two for female having college or university level education.

Becker (1960) exhibited an economic framework to investigate the determinants affecting fertility. Children were considered to be durable good particularly that produce income to parents. Determining factors of fertility were child costs, knowledge, income, uncertainty, and tastes. Demand of children will increase due to reduction in price and increase in income. Quality of the children was precisely associated with quantity disbursed over them. Every household produced their children as children cannot be bought or sold in marketplace. So uncertainty in the production of children (i.e. sex) ultimately created corresponding uncertainty in consumption. That's why the quantity of children in a particular family depended upon its demand as well as its ability to produce or supply them. Some families are unable to produce as many children as they desired and some have to produce more than they desired. Therefore, actual fertility may diverge considerably from desired fertility.

A research study was conducted by Irma Adleman, (Adleman, 1963) in which age-specific birth rates in various countries of the world (The sample consisted of 37 countries whose annual per capita income ranges from $125 to $1900) were correlated with several economic and socio-cultural variables such as urbanization, industrialization and education over the long run. The validity of this cross-country approach was tested by computing separate regression equations- one for developed and the other for the under-developed countries. No statistically significant differences in regression coefficients emerged, which indicated that the basic postulate of the cross section technique i.e. homogeneity of population response was satisfied. This study showed that mothers' level of education exerts significant influence upon child bearing behavior. Her analysis showed a clear inverse correlation between educational years of wife and family size. Since there existed no international data on educational index for female. The regression coefficient of birth rates,

with respect to the educational index was found negative and statistically significant. Quantitatively, among all the variables, a one percentage change in the index of education appeared to exert the largest absolute influence upon age-specific birth rates.

A study (as cited in Agarwala 1972) showed mean number of children born to families of age fifteen and above conducted in Banglore City who were either illiterate or could barely read and write or those who were educated up to middle school were very nearly the same that in between 5.3 and 5.5 children. However, women who were educated up to high school or more gave birth to only 3.9 children. Part of the difference was due to higher marriage age of those who were educated up to high school or more. But when the averages were standardized by duration and age of marriage, the difference between the two groups persisted.

However, Siegel (2012) observed that during previous thirty years the US total fertility rate is properly constant while female wages had continuously raise. He perceived that females' hour spent on housekeeping have dropped but men's have improved.

Ushie (2014) considered fertility differentials in two settlements which included Anantigha as an urban settlement in Calabar and Bendi as a rural settlement in Obanliku. The population sample of 900 households was used that was consisting of married men and women. Findings showed that both settlements had same variation in age entry to marriage even though there was a significant difference in fertility differentials in the study area.

Reja and Mukherjee (2015) worked on overall fertility levels among three Asian countries namely Bangladesh, India and Indonesia. They found that total Fertility Rate was declining gradually within and across the countries but the pace of decline varied.

Vogl (2015) studied variations in fertility and human capital over the demographic transition. The results suggested that associations between income and fertility were hump-shaped in the beginning. With

economically developed, top of hump shifted to left, and ability circulation shifted to right, this makes the link of income or skill with fertility to move from positive to negative.

Kim (2016) stated that better-educated females have lesser children than low levels of education of women in both developed as well as developing countries. The reason for this was the benefits of education beyond the value of women's time. Education could reduce fertility because better-educated women earned more and might raise their children more effectively.

Yasmeen (2016) intended to obtain coherent forecasts for the age-specific fertility for Pakistan of the two broader areas, urban and rural. She used Coherent Functional Models for mortality forecasting. Results have shown that, on average, rural females had greater fertility rates comparing with their urban dwellers in all age-groups since 1984. Substantial negative association among percentage of urban inhabitants and fertility rate lead to the result that change in reproductive behavior among the females of two polar mostly from alterations in the socio-economic circumstances, especially from variances in the level of education, literacy rate and age at marriage. Forecasts of future fertility rates showed that these differences were expected to be maintained over the next twenty years. The results were reliable with the findings of Yasmeen Fatima and Mahmood (2014), Yasmeen F and Mahmood Z (2012) and Hyndman R & Khandakar Y (2008) that the overall fertility rates were decreasing.

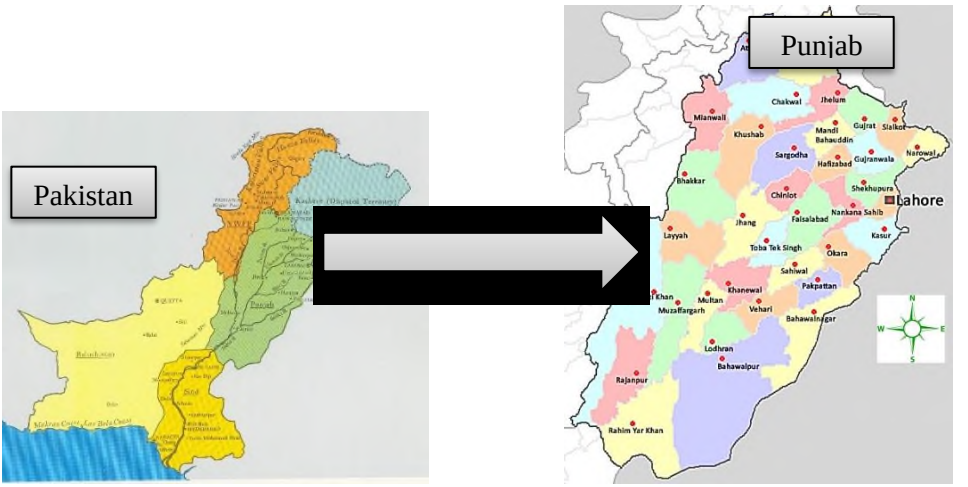
A variation in fertility between urban and rural populations had been explored by Khan (2013) for Punjab and specifically Bahawalpur district and also looked into the reasons of fertility variations between them. Computation and comparison of fertility levels for all of the concerned urban and rural areas showed the fertility gap between them which highlighted the notable differences in fertility rate of both the areas. The difference in reproduction behavior result in an opposite relationship among percentage of urban inhabitants and fertility rate which actually come from the socio-economic differences particularly the differences in education level, rate of literacy and marriage age. The focus is proposed to

be on rural areas for policy formulation and implementation, since most of the population was settled there in case of Punjab.

3. Methodology

3.1. Study Area

Pakistan mainly consists of Punjab, Sindh, Khyber Pakhtun Khaw, Baluchistan, Azad Jammu and Kashmir and Gilgit Baltistan. Though, major province is Punjab according to its population size, establishes 29 percent reported area, forms 55 percent population and constitute 57 percent of cultivated area and 69 percent of cropped area for agricultural production of the country (Government of Punjab 2016).



3.2. Description and Data Source

This study used dataset of Multiple Indicator Cluster Survey 2013-14 conducted and disseminated by Bureau of Statistics, Government of the Punjab (2016) with the collaboration of UNICEF. Household data for MICS 2017-18 is not available yet so that's why the study is study last available dataset of MICS 2013-14. Dependent variable is Total Fertility Rate, whereas income inequality at district level of Punjab province of Pakistan is used as independent variable in the model. Data for total income of households is taken from Multiple Indicator Cluster Survey (MICS, 2013-14). Income inequality for thirty six districts of Punjab is calculated by Mean Log Deviation. Stata 12 is used for data analysis.

3.3. Econometric Modeling

By definition, linear regression deals with the linear relationships among dependent and independent variables. That's why, it assumes there is a straight-line relationship between them. Least square regression is undoubtedly a useful and important technique.

Ordinary Least Square (OLS) method is used to estimate the model. The model is given below:

$$TFR_d = f\,(MLD_d, U5M_d, UN_d, CPT_d)$$
$$TFR_d = \alpha_d + \beta_0\, MLD_d + \beta_1 U5M_d + \beta_2\, UN_d + \beta_3\, CPT_d + \varepsilon_d$$

Here;
TFR = Total Fertility Rate of d^{th} district.
MLD = Coefficient of Inequality of d^{th} district.
U5M = Under-5 Mortality of d^{th} district
UN = Unemployment Rate of d^{th} district
CPT = Contraceptive Use of d^{th} district
ε_d = *Error Term*
d = 1, 2, 3, ……. , 36.

4. Results and Discussion

This section clarifies the achieved outcomes as reported by objectives of the present paper. Though, formation of this section will be in a way given below:

4.1. District Ranking
4.2. Frequency Tables
4.3. Econometric Model

4.1. District Ranking

Table-1: District Ranking of Total Fertility Rate (TFR)

Rank	District	TFR	Rank	District	TFR	Rank	District	TFR
1	Rajanpur	6.2	13	Multan	3.6	25	Mianwali	3.3
2	D.G.Khan	4.9	14	Layyah	3.5	26	Chiniot	3.2
3	Muzaffargarh	4.6	15	Nankana sahib	3.5	27	Mandi Bahauddin	3.1
4	Kasur	4.5	16	Sheikhupura	3.5	28	Sialkot	3.1

5	Narowal	4.3	17	Bahawalnagar	3.4	29	Lahore	3.1
6	Lodhran	3.9	18	Faisalabad	3.4	30	Rawalpindi	3.1
7	Sahiwal	3.9	19	Khanewal	3.4	31	Attock	3
8	Bhakkar	3.9	20	RahimYKhan	3.3	32	Gujrat	2.9
9	Bahawalpur	3.8	21	T.T.Singh	3.3	33	Vehari	2.8
10	Okara	3.8	22	Gujranwala	3.3	34	Chakwal	2.7
11	Jhang	3.7	23	Hafizabad	3.3	35	Sargodha	2.6
12	Pakpattan	3.7	24	Khushab	3.3	36	Jhelum	2.3

Source: Author's Calculation.

Table 1 demonstrates rank and position of total fertility rate for the districts of Punjab according to total fertility rate. This is obvious from the above Table that Rajanpur, D. G. Khan and Muzaffargarh are the most populated districts with highest fertility rate. While Bahawalnagar, Faisalabad, Khanewal and RahimYar Khan are having the moderate total fertility rates. Chakwal, Sargodha and Jhelum are the least populated districts with lowest fertility rate in Punjab.

Table-2: District Ranking of Income Inequality.

Rank	Districts	Income Inequality	Rank	Districts	Income Inequality
1	Jhelum	0.2301	19	Sahiwal	0.4638
2	Attok	0.2955	20	Mandibahauddin	0.4890
3	Rawalpindi	0.3203	21	Okara	0.4898
4	Chakwal	0.3631	22	Nankana sahib	0.2476
5	Sheikhupura	0.2508	23	Vehari	0.3030
6	Hafizabad	0.2605	24	Multan	0.3286
7	Narowal	0.2641	25	Bahawalpur	0.4225
8	Sargodha	0.2642	26	Bahawalnagar	0.5065
9	Gujranwala	0.2723	27	Khanewal	0.5110
10	Lahore	0.2880	28	Lodhran	0.5229

11	Chiniot	0.3038	29	Rahimykhan	0.5759
12	Faisalabad	0.3052	30	Layyah	0.2878
13	Gujrat	0.3211	31	Mianwali	0.4069
14	Tobateksingh	0.3227	32	Bhakkar	0.4517
15	Pakpattan	0.3365	33	Khushab	0.4772
16	Sialkot	0.3486	34	Muzaffargarh	0.6685
17	Jhang	0.3811	35	Deragkhan	0.7251
18	Kasur	0.3912	36	Rajanpur	0.8226

Source: Author's Calculation.

4.2. Frequency Tables

Parametric as well as non-parametric approaches both have advantages and disadvantages also. Non-Parametric approach is more data intensive and henceforth might be more appropriate even in case of large data set. Though, this does not necessitates a defined functional form and might not imposed of certain assumptions. Conversely, parametric approach may not be flexible in its nature as it requires any well-defined functional form (Singh, 2010).

Now the question arises that should the level of fertility in Northern low income inequality group is similar to the level in central low inequality set? Likewise, would the level of mortality and literacy rate for all four regions with high income inequality be the same or not? This serious issue is handled in this section.

Table 1: Frequency distribution of districts controlling for regional effects

Regions	Inequality Score	
	High (0.45+)	Low (<0.45)
North	0	4
Center	3	14

South	4	4
West	2	5
Total Districts	10	26

Source: Author's Calculation.

In Table 1, sample distribution of all four regions is presented according to inequality level. Inequality among these regions is calculated by mean log deviation (MLD). Then all four regions are assigned high and low inequality score. Districts are divided under high income inequality group and low income inequality group. In north Punjab no district falls in the group of high income inequality group and all four districts lie in low income inequality group. In central Punjab, total districts are 17, from which 3 districts falls in high income inequality set and 14 districts lies in low income inequality group. In southern Punjab, 4 districts are in high income inequality group and four lies in low income inequality group. Total 07 districts are included in western Punjab from which only two are fell in high income inequality category.

In this step, mean fertility rate is calculated controlling for regional effects. Mean fertility rate is 2.8 for North having low income inequality. It is revealed that low income inequality has compressed the size of mean fertility rate. So, we can say that in equality contributed to small family size. Districts of central, southern and western Punjab that have low inequality also have low mean fertility rate but the district that falls in high income inequality category have high mean fertility rate. This indicated that low inequality is good for small family size.

Table 2: Mean fertility rate by regional income inequality

Regions	Inequality Score	
	High (0.45+)	Low (<0.45)
North	0	(2.8) 4
Center	(3.6) 3	(3.4)14
South	(3.5) 4	(3.4) 4

West	(4.6) 5	(3.4) 2

Source: Author's Calculation.

Table 3: Mean under-five mortality rate by regional income inequality

Regions	Inequality Score	
	High (0.45+)	Low (<0.45)
North	0	(65.5) 4
Center	(114.66) 3	(95.85)14
South	(112.25) 4	(101.25) 4
West	(105.2) 5	(80) 2

Source: Author's Calculation.

Low inequality results in low mean under-five mortality rate. Districts with low inequality score have low levels of mean under five mortality rates that is 65.5. Districts of all four regions having low income inequality also have low mean under-five mortality rate. But the districts that are having high inequality score have high mean under-five mortality rate and fertility rate as mentioned in the table. For South and West Punjab, the difference in mean under-five mortality rate between low and high income inequality groups with each group is as larger as that between them.

Table 4: Mean female literacy rate by regional income inequality

Regions	Inequality Score	
	High (0.45+)	Low (<0.45)
North	0	(41.2) 4
Center	(41.36) 3	(51.97)14
South	(34.95) 4	(49.3) 4

West	(56.64) 5	(60.55) 2

Source: Author's Calculation.

Since high income inequality results low mean female literacy rates. It is assumed that others effects remain the same, the greater the income inequality score, lesser will be the average literacy rates. Put differently, lower the income inequality, higher would be the mean literacy rates as a whole.

In other words, although under-five mortality rates and level of education are two important mechanisms through which economic development translates itself in reducing a country's fertility level, the four tables presented here demonstrates the importance of income inequality in determining the level of these two variables.

4.3. Econometric Analysis

Total fertility rate for thirty six districts of Punjab is taken as dependent variable. Coefficient of Mean Log Deviation calculated and is considered as an independent variable to check the effect of distribution of income on fertility rates.

Table 5: Inequality and Fertility Model

Dependent Variable: Total Fertility Rate				
Independent Variables	Coefficient	Std.Error	t-stat	Prob. value
U5M	.008794	.0043	2.04	0.050
Unemp	.114141	.0424	2.69	0.011
Contr	-.031975	.0130	-2.45	0.020
Coef.Ineq	.947579	.6838	1.39	0.176
Constant	-7.03117	4.040	-1.74	0.092
R-sq.	0.5121	F-stat	8.13	

Adj R-sq.	0.4492	Prob.	0.0001	

Source: Author's Calculation.

Table 5 shows the positive effect of income inequality upon the level of fertility. This is a significant outcome for the reason that till now, we are observing at the influence of income and wealth of a country's fertility without taking into account the nature of the distribution of economic resources.

Empirical results of econometric model indicate that under-five mortality has significant and positive relationship with total fertility among districts of Punjab. With the 1 level increase in mortality rate, total fertility rate will be increased by .0087 level. Probability value shows that Under-five mortality rate is significant at 95 percent. Coefficient of Inequality is positive and significant with total fertility rate. With 1 level increase in inequality, total fertility rate will be increased by .94 levels. Probability value shows that Coefficient of inequality is significant at 83 percent. Contraceptive use has negative but significant relationship with total fertility rate. With 1 level increase in contraceptive use, total fertility rate will be decreased by .03 levels. Probability value shows that contraceptive use is significant at 98 percent. All variables have significant probability values having significant relationship with total fertility.

5. Conclusion and Policy Implications

Concluding the paper, cross sectional empirical analysis was incorporated to explore effect of various socioeconomic determinants on fertility for the districts of Punjab. In the empirical analysis, total fertility rate is considered as outcome variable whereas income inequality, employment rate, under-five mortality and contraceptive use were considered as independent variables. The lessons obtained from the findings of the paper are given as:

Firstly, empirical results of this study indicate that contraceptive use has negative relationship and significant association with total fertility rate. Results are associated with empirical indication on the association between contraceptive usage and fertility as is shown by Gupta 2003 and

Bongaarts 1978. Result shows that contraceptive use in Societies like Pakistan is mainly for gap purpose and not for ending family size. Couples used contraceptives after completing their ideal number of children. It is the fact that fertility plans of Pakistani couples are very high. Religion may also be the reason as the finding is proved by Bhatti 2015. On the whole, contraceptive use has strong impact on fertility rates.

Secondly, the employment rate employs statistically significant and positive influence on fertility as is proved by Hakim 1994 and Bloom 2009.

Thirdly, according to the results of this study, reduction in under-five mortality might be supportive to decrease fertility for the districts of Punjab. It is found that under-five mortality has substantial relationship with fertility. Lesser under-five mortality leads to lesser fertility rates.

Lastly, income inequality has positive relationship with total fertility rate and significant variable in determining fertility rate. Inequality of income affects socioeconomic status of poor families which has significant influence on child development. So that's why low income inequality at districts results in low fertility rates and high child development.

It is suggested for the policy recommendation that development in human capital particularly females welfare through child health and contraceptive knowledge might the greatest policy choice to decrease fertility levels amongst various districts of Punjab. It is recommended that governmental setting up of social services regarding to child healthiness and contraceptive knowledge may enhance social welfare and child life expectancy that may be beneficial to decrease fertility levels.

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