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BONGAARTS PROXIMATE DETERMINANTS OF FERTILITY MODEL: A REGION BASED ANALYSIS IN PAKISTAN

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ABSTRACT
Present study aimed to explore the effects of proximate determinants on slow paced fertility transition in Pakistan from 1990 to 2013. Regional fertility disparities among Provinces, using three data sets of Pakistan Demographic and Health Surveys (1990-91, 2006-07 and 2012-13) have been analysed. Bongaarts (1978) model is used to estimate the effects of marriage, contraception, induced abortion; postpartum infecundability and primary sterility on fertility transitions. The findings exhibit that postpartum infecundability is the strongest and powerful inhibitory factor of fertility followed by marriage pattern. Contraception and induced abortion remained less contributing factors in controlling Total Fertility Rate in early 1990s but afterwards, increased involvement are being observed steadily; while primary sterility stayed behind the least contributing factor in declining fertility. In conclusion, this study suggests that in prevailing traditional, socio-cultural and orthodoxy society; open consultation regarding reproductive health and contraceptive practice should be encouraged through mass media campaign. Moreover; couples should also be encouraged for sterilization after achieving desired family size for controlling the mammoth population in Pakistan.

KEYWORDS: Total Fertility Rate, Bongaarts model of Proximate Determinants, Relative and Absolute contribution, Pakistan

1. INTRODUCTION
Population dynamics has three principal components and fertility[1] is one of them while others two are mortality and migration. Fertility is a time variant phenomenon which changes over time and affected by socio-cultural and behavioral factors. It varies categorically among different countries and cultures depending upon the adopted family planning techniques which implemented and monitored differently. Reducing population growth is a considerable task which has direct repercussions for all other key progressive problems, facing by Pakistan these days. Though, deliberate fertility control has got better research attention on changing the attitudes and behaviors of couples by delaying marriages and breastfeeding duration, adopting modern contraceptive methods or induced abortions but its implementation is still considerably very low. Even, understanding about the fertile period is extremely very low because only 4 percent women and 7 percent men appropriately recognized the fertile period as intermediate between women's menstrual periods (Pakistan Demographic and Health Survey, 2012-13). It also seems difficult to support voluntary birth control method in a conventional and traditional Muslim society of Pakistan due to the social, economic and cultural inequalities and lack of easy accessibility to birth control tools and techniques.

Traditional concepts of fertility, for instance, bringing up sons for paying more attention to their parents when they grow old and preferring boys over girls, are strongly adhered on the people's mind, which increases the fertility rate. Government sector remains the key supplier of contraceptives, satisfying the requirements of almost one in two consumers (46 percent). With appropriate family planning services, unplanned pregnancies could be decreased which results in slow population growth.

The levels and trends in fertility are deeply affected by a range of demographic, physiological, traditional, socio-economic, behavioural, and environmental factors. However, on the basis of empirical facts, Bongaarts disagreed that many variations in fertility levels are associated to the various impacts of four factors called Proximate Determinants (PDs) of fertility i.e. marriage, contraceptives use, postpartum/lactational infecundability and induced abortions (Bongaarts 1978). Total Fertility Rate[2] (TFR) is a standard measure of fertility and is deeply persuaded by the PDs. PDs remain varying over time, and generate various levels of control on TFR that continuously veiled if fertility transition is analyze only by the levels of TFR. Sathar and Casterline (1998) examined the slow paced fertility transition in Pakistan. They argued that the reduction is mild however; it signifies a real break from the earlier period, remarkably for the reason that the use of modern contraception has been increased in controlling family size. They also argued that more contraceptive use led to decrease in marital fertility and every demographic examination point out a reduction in fertility during 1990s. Although, a logical clarification for the importance of 1990's period in reducing fertility was not accessible, that would be consistent with the macroeconomic theory of fertility. Soomro (2000) re-examined these three weak areas of study including the important role of contraceptives in fertility transition, decline in marital fertility and the consequence of 1990's period using PDs by Bongaarts. He viewed the slow pace of fertility transition within the framework of Bongaarts transition model and concluded that Pakistan has been passing through the earlier stage of transition phase. Role of contraception in reducing fertility is very low. Whereas, increase in delay marriages and breastfeeding practice have been playing vital roles in decreasing TFR level and marital fertility has remained constant. Main objective of this study is to inspect the effects of PDs (marriage, contraception, induced abortion, postpartum infecundability and primary sterility) on fertility transition among all regions. Remainder of the study is structured as follows; part 2 provides existing reviews of literature. Data sources, methodological framework, econometric models and estimation techniques are presented in section 3. Section 4 presents the results and

[1] Term "fertility" can be defined in various ways, for instance; in medical terminology it is "the ability of woman to conceive and have children, capability to get pregnant through regular sexual activity" (Medicine Net.com, 2010). Terms fertility, fecundity and fecundability are often used mutually in demographic studies. Demographical definition of fertility can be defined as "output of reproduction rather than ability to have children". Term fecundity is called as the physiological ability of women to have children that is apparent generally, during menarche (beginning of menstruation cycle) and menopause (ending of menstruation cycle). Term fecundability is the possibility to conceive that depends upon the pattern of intercourse and preventive behavior of pregnancy (Frank, 2008).

[2] Total number of children born per woman

discussion while the last segment presents the conclusions and recommendations.

2 Literature Reviews

Davis and Blake (1956), proposed a classical framework for analyzing the fertility determinants. As stated, fertility level in a society is directly influenced by a large set of variables called intermediate variable. They categorized them into three main groups i.e. intercourse variables, conception variables and gestation variables. They also recognized the mechanism through which some socio-economic, cultural and human's behavior co-operate (Indirect) with the biological (Direct) determinants of fertility. Though, framework did not present a proper mechanism for quantitative analysis. Bongaarts (1978; 1982) documented a slight change by reducing the set of PDs and established a comparatively simple model to measure the fertility effects. Classification of small set of PDs led to the establishment of comparatively basic model that quantifies the fertility effects. Bongaarts and Potter (1983) using the data of 41 developed and developing countries, found that 96 percent of variation in TFR could be explained by the four principal PDs of fertility. They suggested an age-specific version of PDs which is broadly practiced in fertility analysis for assessing the quantitative effect of PDs. Martin (2017) studied the trends of PD of fertility in Namibia during the period of 1992-2013. The study used NDHS[1] (1992, 2000, 2006 and 2013) for estimating TFR by Bongaarts model. Outcomes showed that TFR has decreased by 1.8 live births i.e. from 5.4 to 3.6 children per woman from 1992 to 2006. Role of marriage index in explaining fertility levels and trends is found to be higher as compared to other indices. Finlay, et al. (2016) employed DHS for 21 Sub-Sahara African countries (SSA) between 1990 and 2014. They observed different trends of fertility by wealth status using Bongaarts criterion. They found that fertility has dropped in SSA among the richest households, not among the poorest which interprets to an intentional decrease in TFR. They also discovered that durations of breastfeeding are generally decreasing, driving higher pressure on fertility rate while contraceptive practice has also increased amongst the richest quintiles and dropped fertility. Majumder and Ram (2015) used DHS surveys of six nominated Asian countries including India, Bangladesh, Nepal, Vietnam, Indonesia and Philippines. Bongaarts model be used to measure the effects of PDs of fertility between poor and rich women. They conducted a stratified study by wealth quintiles in South Asian framework and found that reduced fertility regardless of the economic status of women throughout the Asian countries, complemented by the frequencies of contraceptive. Even though, regardless of married women confirming the maximum number of live births, marriage have shown the maximum fertility inhibiting effect that accounts for around 40 percent fertility drop since its biological maximum i.e. 19.10 children per woman (Mumbi and Charles, 2016; Islam, et al., 2011). The outcomes showed that amongst other PDs, postpartum infecundity was found second highly significant determinants in reducing TFR i.e., nearly 22 percent (Alene and Worku, 2009; Mekonnen and Worku, 2011) in Ethiopia, Oman (Islam, et al., 2011) and Malawi (Palamuleni, 2010). Singh, et al. (1993) found that in Zambia, among married women the contraception use shows highest fertility inhibiting effects as compared to other PDs because about

[3] Namibia Demographic and Health Survey

77 percent of married women having used at least one type of modern contraception. Hollerbach, et al. (1983) discovered that significance of contraception and marriage pattern is essential in reducing fertility of Cuba. Sekhar (2004) exposed that fertility reduction is mainly a phenomenon of increasing contraceptive usage and lengthy period of existing insusceptible era in the prevailing culture of India. Nai, et al. (2011) applied Vital Statistics (2004), Population Census (2000) and MPFS[2] (2004) survey data of Peninsular Malaysia on Bongaarts model and proved that delaying marriage and contraceptive use are the two vital PD that have high fertility inhibiting effects in contrast to others however; the effects varies across the ethnic groups. Abeykoon (2009) applied Bongaarts Model to SDHS[3] data (2006-07) and proves that induced abortion rate has increased from a low level in the beginning of 1990s to a peak level and afterward dropped. Research emphasized on the needs of family planning service and educational programs that lead to the active use of contraceptive techniques and decreased induced abortion.

Rashedul Islam, et al. (2015) employed Bongaarts Model for measuring correct value of TFR using numerous BDHS[4] (1993-94, 1996-97, 1999-2000, 2004, 2007 and 2011). Their analyses showed that contraceptive practice is playing an important role in fertility variations. Nurul Islam, et al. (2014) used BCPS[5], BFS[6] and BDHS of (1975-2007). Outcomes showed that induced abortion as one of the well-thought indicator, used for measuring PDs of fertility. However, additional potential aspects i.e. miscarriage and abortion are also vital determinants for fertility reduction. Mahjabeena, et al. (2011) used BNDS[7] for (1975-2011) on Bongaarts Model for reckoning nearly correct value of TFR. Impact of each PD attained through the analysis of TFR by breaking down time period of 1975 to 2011 into four stages. Their analyses evidently specified that contraceptive exercise plays main role in fertility variations. The results offered a foundation to draw out few policy implementations and suggest different recommendations for TFR reduction in Bangladesh. Rezaul, et al. (2016) utilized various data sets of BCPS, BFS and BDHS for estimating PDs using Bongaarts Model. They employed Linear Regression Analysis for attaining the target TFR and regression coefficient confirmed that TFR declined whereas the Contraceptive Prevalence Rate (CPR) has increased during the investigated period of 1980-2007. Every index of PD showed a downward trend due to the effective use of contraceptive practice. Mean age at marriage and CPR rose from 15 to 18.95 years and 18.6 to 56.0, respectively which led to a decreased in TFR i.e. 4.99 to 2.7 children per woman in Bangladesh. Aziz (1994) made an effort to decompose the effects of TFR by applying the Bongaarts model in Pakistan. She obtained data from various sources of PFS[8] (1974-75), PCPS[9] (1984-85),

[4] Malaysian Population and Family Survey
[5] Sri Lanka Demographic and Health Survey
[6] Bangladesh Demographic and Health Survey
[7] Bangladesh Contraceptive Prevalence Survey
[8] Bangladesh Fertility Survey
[9] Bangladesh Nationwide Demographic Survey
[10] Pakistan Fertility Survey
[11] Pakistan Contraceptive Prevalence Survey

PDHS[10] (1990-91), and PFPI[11] (1993). Her findings showed that in all four surveys, postpartum infecundability found to have most significant fertility inhibiting effect followed by the proportion of married women while contraception came out as the least influential determinant of TFR. Postpartum infecundability condensed fertility by 32-37 percent. During the period of 1974 to 1993, fertility inhibiting effect of age at first marriage increased from 22 percent to 33 percent. Sathar and Zaidi (2009) used data sets of PDHS (1990-91 and 2006-07), PRHFPS[12] (2000-2001) on Bongaarts model to study the fertility prospects in Pakistan from 1990 to 2007. The outcomes revealed that over the sixteen years of time period, the inhibiting effects of marriage, contraception and abortion have all increased, whereas the effect of postpartum infecundity has fundamentally remained unchanged. In 1990, marriage and postpartum infecundity had shown the highest inhibiting effects on fertility reduction but during 2007, marriage had become the strongest determinant in declining fertility followed by contraception. Nasir, et al. (2015) addressed some of the ignored non-program magnitudes linked to fertility change in Pakistan using data from PDHS (1990-91 and 2006-07) and PRHFPS (2000-01). They explored the role of key PDs of fertility using Bongaarts to examine the fertility change from 1990 to 2012. The findings indicated that marriage timings and use of contraceptive are fundamental in dropping fertility of Pakistan.

3. Data and Empirical Methodology

This study used three data sets of PDHS (1990-91, 2006-07 and 2012-13) and applied Bongaarts (1978) model. Precisely, it is an attempt to articulate the conceptual framework of PDs among all regions for understanding the mechanism through which different intermediate factors influence the fertility transitions from 1990 to 2013. The study first computed the quantitative indices and afterwards fertility inhibiting effects (the relative and absolute contribution) of each determinant are being analyzed. Bongaarts criterion of synthetic fertility transition is also planned to check to the current position of Pakistan.

3.1 Measurement of Proximate Determinants (PDs) of Fertility

3.1.1 Multiplicative Model of Total Fertility Rate (TFR) at Aggregated Level

Total Fertility Rate (TFR) is termed as the average number of children that every women would like to have from a hypothetical women's cohort. Women are exposed to fertility rates from the beginning of their reproductive period i.e. aged 15 until the end of it i.e. aged 49 years. TFR is expressed as the product of five principal Proximate Determinants (PDs) of fertility i.e. (1) marriage (2) contraception (3) induced abortion (4) postpartum Infecundability and (5) primary sterility. On the basis of these five indices, a subsequent multiplicative model of PDs of fertility is expressed as;

$$\mathrm{TFR} = \mathrm{C_m} \times \mathrm{C_c} \times \mathrm{C_a} \times \mathrm{C_i} \times \mathrm{C_p} \times \mathrm{TF} \ldots (\mathrm{A})$$

Where;

[12] Pakistan Demographic and Health Survey
[13] Population and Family Planning Indicators Survey
[14] Pakistan Reproductive Health and Family Planning Survey

C_m Index of marriage
C_c Index of contraception
C_a Index of induced abortion
C_i Index of post-partum infecundability
C_p Index of primary sterility
TF Total Fecundity

Indices can only take the values in between 0 and 1. When there is no fertility inhibiting effect of a given proximate variable, index takes the value equals to 1 and if the fertility inhibiting effect is completed; index takes the value 0. Hence, closer the index to 1 the smaller the fertility inhibiting effect of PD. TF is the natural ability of woman to reproduce. Total Fecundity Rate is the average number of live births anticipated by a woman who throughout her whole reproductive phase remained married, never used any contraceptives, never had any induced abortion and never breastfed their children. Thus, TF is the hypothetical value of TFR that would be perceived in a population where all inhibiting effects of the PDs are absent, i.e. $C_m = C_c = C_a = C_i = C_p = 1$. TF is found to fluctuate between 13 and 17; however, Bongaarts has recommended the mean value of 15.2 births when analyzing the model.

3.1.2 Measurement of Indices at Disaggregated Level

3.1.2.1 Index of Marriage (C_m)

Generally, woman's fertility is a result of three different phases. Firstly, the woman should be adult (aged 15) and involves in marital relations. Bongaarts recognized this phase as prime determinant of fertility and called it as the proportion of married women. This proportion of married women is stated as "index of marriage" (C_m). To make a quantitative measurement about the effect of marriage index (C_m) on fertility, the indices of Total Fertility Rate (TFR) and Total Marital Fertility Rate (TMFR) are calculated. Metaphorically; it is accessible through the subsequent form;

$$C_m = \frac{\sum_{x=a}^{b} f(x)}{\sum_{x=a}^{b} f(x)/m(x)}$$

$$C_m = \frac{TFR}{TMFR} \dots (1)$$

Where;
C_m Weighted average of the age-specific proportion of married women
$m(x)$ Percentage of currently married women aged x years
$f(x)$ It is computed by taking the ratio of Age Specific Fertility Rates (ASFR) by the percentage of women who are currently married at each age x multiplied by 5
a Natural lower age limit (generally 15 years)
b Natural upper age limit (generally 49 years)

If the calculated index value equals to 0, it indicates that fertility is completely confined with the absence of marriage and equals to 1 show that all women of reproductive age are married. These two extreme values of index (0, 1) seem relatively unrealistic in any community. A specific index value, for instance, 0.6 states that fertility is decreased as a consequence of 40 percent women being sexually inactive during their whole reproductive phase that's why the (C_m) gives the proportion by which TFR is smaller than TMFR[15].

3.1.2.2 Index of Contraception (C_c)

Secondly, intercourse leads to conception, this phase of conception might be regulated by practicing contraception technology. Bongaarts recognized it as a significant phase of fertility and specifically called it 'contraceptive use' in addition to abstinence and sterilization. Contraceptive use is denoted as "index of contraception" (C_c) and metaphorically it is accessible by means of the subsequent form:

$$C_c = 1 - 1.08\ u * e \ldots (2)$$

Where;

u Proportion of married women (who are in their reproductive age) presently using contraceptives

e Average method effectiveness use of contraception

1.08 Sterility Correction Factor or the Adjustment Factor for sterilization is based on a hypothesis that every contraceptive consumer might not be fertile when practicing contraceptives and a low percentage of infecund women may perhaps exercising contraceptives lacking knowledge about their own fecundity (Nortman, 1980).

The estimates of contraceptive effectiveness are not easy to find. So, Bongaarts (1982) suggested some standard method for particular values, commonly used in calculating the average effectiveness levels in most developing countries (see Table 01). The value of 'e' could be estimated by means of weighted average of specific use effectiveness, i.e. any method 'm' ,'e_m', by the percentage of women who are practicing a given method, u_m through subsequent form;

$$u = \sum u_m$$

$$e = \frac{\sum e_m * u_m}{\sum u_m} \ldots (3)$$

[15] This stands for fertility levels when the effects of contraception and induced abortion are added to the combined effects of three indices except C_m and is calculated by;

$$TMFR = C_c * C_a * C_i * 15.3$$

If the calculated value of contraception index equals to 1 validates the absence of contraception method and 0 shows that every fertile women exercise hundred percents efficient contraception.

3.1.2.3 Index of Induced Abortion (C_a)

Thirdly marital intercourse leads to conception which is then followed by pregnancy and birth. These two stages might leads to miscarriage, stillbirth and abortion. Bongaarts recognized such phase as third PD of fertility and specified it as “index of induced abortion”. It shows woman’s average number of induced abortions at the completion of her reproductive phase and metaphorically it may be accessed by subsequent form:

$$C_a = \frac{TFR}{TFR + 0.4(1+u) \times TAR} \ldots (4)$$

TAR	Total Abortion Rate
$0.4(1+u)$	An approximation of live births terminated by abortions

If the calculated value of abortion index equals to 1 that represents lack of induced abortions and 0 represents every live birth is aborted. Total Abortion Rate (TAR) and contraceptive prevalence rate (u) are required to calculate C_a. TAR is assumed to be unknown so; it can be computed by rearranging the Eq. (4)

$$TAR = \frac{TFR\,(1 - C_a)}{C_a \times 0.4(1+u)} \ldots (5)$$

3.1.2.4 Index of Postpartum Infecundability (C_i)

Lastly, later then birth, woman entered in another phase of postpartum. It is a phase when woman tries to adjust mentally as well as physiologically to the procedure of conception. Bongaarts recognized it as “post-partum infecundability” or in other words “period of post-partum amenorrhea[13]”. Index of post-partum infecundability (C_i) is attainable with the subsequent form[14];

$$C_i = \frac{20}{18.5 + i} \ldots (6)$$

[16] It is describes as a phase between childbirth and the continuation of menstruation after delivery, that usually estimates the coming back of ovulation. This phase is mainly calculated by the length of breastfeeding and the risk of becoming pregnant is extremely low. Therefore, in this period, a woman is considered as infecund/amenorrheic.

[17] **Calculation**

Infecundable interval immediately following a birth=1.5 months.
Waiting time to conception= 7.5 months.
Time added by intrauterine mortality = 2 months/birth interval.
Gestation period ending a live birth = 9 months.
Thus, without lactation, a typical average birth interval can be estimated: 1.5+7.5+2+9 = 20 months.
With lactation, it equals the period of lactational infecundability i.e. by adding (7.5+2+9) equals 18.5 months.
Ratio of average birth intervals without and with lactation is called the Index of Postpartum Infecundability.

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Where; i

The mean/median period of postpartum infecundability is calculated in months and accounted by lactation /postpartum abstinence.

Average duration of breastfeeding in months is required to calculate the value of 'i' as breastfeeding practice has an inhibitory effect on ovulation and therefore, it extends the birth interval and decreases TNMFR[15]. If the calculated value equals to 1 specifies lack of breastfeeding and postpartum abstinence and 0 specifies the duration of infecundability goes to infinity. Index of post-partum infecundability (C_i) is calculated by following two methods.

1 Direct Method

When postpartum infertility can be estimated in a direct manner by taking the median duration lactational length using subsequent algorithm;

$$\mathrm{i} = 1.5 + (0.56 * \text{median duration of breastfeeding}) \dots (6A)$$

2 Indirect Method

If direct estimates are not available, value of 'i' can also be calculated to obtain an approximate value from the duration of Breastfeeding 'B', by using following equation;

$$\mathrm{i} = 1.753 \exp(0.139 \times \mathrm{B} - 0.001872 \times \mathrm{B}^2) \dots (6B)$$

3.1.2.5 Index of Primary Sterility (C_p)

Sterility is the state when a woman seems incapable to conceive or in other words when a pregnancy does not effectively end in a live birth. Generally, women are considered sterile before menarche and after menopause. Primary sterility may be described as the absolute incapability to conceive which might be due to Sexually Transmitted Diseases (STDs). Furthermore, STDs could lead to secondary sterility signifies that the incapability to have more children although the menopause has not been reached as at least one child has been born. It is expressed as;

$$\mathrm{C_p} = (7.63 - \frac{0.11s}{7.3}) \dots (7)$$

Where,

S proportion of ever married women aged (45-49 years) who have had no live births in the past five years.

For developing countries, Frank (1983) set the standard rate for sterility at 3 percent. If $C_p \geq 1$ when the percentage of sterility is ≤ 3 percent, indicating that sterility has no inhibitive effect on fertility.

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[18] Total Natural Marital Fertility Rate (TNMFR) measures the fertility levels when the effects of postpartum infecundability are taken into account. It is calculated by the following formula;

$$\mathrm{TNMFR} = \mathrm{C_i} \times \mathrm{TF}$$

$$\mathrm{TF} = \frac{\mathrm{TNMFR}}{\mathrm{C_i}}$$

On the other hand, if the percentage of sterility is greater than 3 percent, then the additional percentage points are assumed to be due to pathological sterility and $C_p < 1$, making sense that it has some inhibiting effect on fertility.

3.2 Total Fertility Inhibiting Effects of Proximate Determinants

3.2.1 Relative Contribution (Percentage Reduction)

To evaluate the relative contribution of fertility inhibiting determinants of fertility in more specific manner, following logarithmic transformation is used:

$$\mathrm{Log}\left(C_m \times C_c \times C_a \times C_i \times C_p\right) = \mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p \ldots \text{(i)}$$

Relative percentage contribution of each PD may be explained in percentage points by means of the subsequent expressions.

$$\text{Effect of Marriage} = \frac{\mathrm{Log}C_m}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times 100 \ldots \text{(ii)}$$

$$\text{Effect of Contraception} = \frac{\mathrm{Log}C_c}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times 100 \ldots \text{(iii)}$$

$$\text{Effect of Abortion} = \frac{\mathrm{Log}C_a}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times 100 \ldots \text{(iv)}$$

$$\text{Effect of Infecundability} = \frac{\mathrm{Log}C_i}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times 100 \ldots \text{(v)}$$

$$\text{Effect of Primary Sterility} = \frac{\mathrm{Log}C_p}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times 100 \ldots \text{(vi)}$$

3.2.2 Absolute Contribution

In order to measure the importance of each PD, Bongaarts model is transformed into following equation;

$$\mathrm{Log(TF)} - \mathrm{Log(TFR)} = \mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p \ldots \text{(vii)}$$

Total fertility inhibiting effect is divided by the percentage of logarithm of each index to the summation of logarithm of all five indices (Wang, 1987). Absolute contribution of each PD may be written as follows;

$$\text{Effect of Marriage} = \frac{\mathrm{Log}C_m}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times [\text{TF} - \text{TFR (estimated)}] \ldots \text{(viii)}$$

$$\text{Effect of Contraception} = \frac{\mathrm{Log}C_c}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times [\text{TF} - \text{TFR (estimated)}] \ldots \text{(ix)}$$

$$\text{Effect of Abortion} = \frac{\mathrm{Log}C_a}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times [\text{TF} - \text{TFR (estimated)}] \ldots \text{(x)}$$

$$\text{Effect of Infecundability} = \frac{\mathrm{Log}C_i}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times [\text{TF} - \text{TFR (estimated)}] \ldots \text{(xi)}$$

$$\text{Effect of Primary Sterility} = \frac{\mathrm{Log}C_p}{\mathrm{Log}C_m + \mathrm{Log}C_c + \mathrm{Log}C_a + \mathrm{Log}C_i + \mathrm{Log}C_p} \times [\text{TF} - \text{TFR (estimated)}] \ldots \text{(xii)}$$

RESULTS AND DISCUSSIONS

4.1 Fertility Trends in Pakistan (1990-2013)

In 1990, Pakistan's ranked was 9th among densely populated country, with a total population of 106.070 million that increased to 182.1 million in 2013. Based on the latest United Nations estimates (2018), Pakistan's Global Rank is 6th with a population of 201,066,352 and it's equal to 2.63 percent of the total world population[16]. Population growth is at surprising rate of 2.4 in 2018 which is no less than double of neighbouring countries like Bangladesh, India and Sri Lanka[17]. The statistics showed reduction in TFR from 5.4, 4.1, 3.8 and 2.6 children per woman in 1991, 2007, 2013 and 2018[18], respectively. During the mentioned period, the practice of modern contraceptive methods amongst newly married women rose from 9 to 22 and then to 26 percent. CPR among women with higher education is recorded as 38, 43 and 44 percent, and among women having no education as 8, 25 and 35 percent, over the period. Noticeable differences in fertility are observed by means of women's level of education as well as wealth quintile. TFR declines with women's education i.e. from 5.4, 4.8 and 4.4 children with no education to 3.6, 2.3 and 2.5 births per woman with higher education. Moreover, fertility and wealth status are highly correlated. TFR among women in the poorest households is found to be higher (5.8 and 5.2 births) than women from the richest households (3 and 2.7 births) during 2007 and 2013, respectively. Customs of early marriages, preference for more sons, high infant (66 per 1,000 live births) and maternal mortality rate (178 per hundred thousand live births), illiteracy and poverty, lack of women's empowerment, polygamy, religious restraints, attitude and traditions and lack of leisure activities are the main causes responsible for high fertility rate (Chaudhry, 2016). In addition, unwillingness of huge population to exercise contraceptives also leads to high fertility rate. Finally, disappointments of appropriate implementation of population planning policies of government are other causes of high fertility rate. For that reason, in the framework of socio-economic development the primary need is to take on the issue of high fertility, effectively and efficiently on priority basis in Pakistan.

During the last 24 years, fertility has reduced by 42.10 percent. Age pattern of fertility rates shows that Pakistani women keep on bearing children over an old age range. Fig. 01 presents the declining fertility trends in Pakistan using the pattern of ASFR. Division of ASFR illustrates a large peak that widened above ages 20-39 years. Examination of fertility transition by different age cohorts exposes that percentage change in fertility has decreased constantly in each age cohorts over the period of 1990-2013. Reduction is rather sharper amongst young women (aged 15-29 years). The steepest reduction in fertility took place among the women of age 15-19 years from 84 births per 1000 women in 1990 to 44 births per 1000 women in 2013, i.e. a decline of more than 47.61 percent while, the reduction in fertility is comparatively slower among women aged 30s-40s. The statistics represents that relative contribution of ASFR to TFR has decreased from 29.3 to 20.5 percent for

[19]Source: www.worldometers.info/world-population/pakistan-population/

[20] Source: editorial@pakistantoday.com.pk.

[21] Sources: World Bank

women under age 25; whereas, it has increased from 70.6 to 79.6 percent for women aged 25 and above (Table 02). This point outs a shift in age pattern of fertility towards old age groups as well as delays marriages. Prolonged reproductive phase is one of the basic characteristics of high TFR fertility and lack of family planning awareness, inadequate access to health centers along with limited educational facilities in rural areas are underlying complex problems. Table 03 indicates that rural women have shown somewhat high TFR as compared to urban women (5.6-4.2 against 4.9-3.2 births). In rural areas, culture of early marriages is very common and high TFR involves the fact that women in young ages have long reproductive phase, thus, undergo to breed more children. After 1990s, TFR had decline in all Provinces but the decline is relatively sharper in Khyber Pakhtunkhwa (5.50-3.90 births per woman) and Punjab (5.4-3.8 live births), accounted for approximately 30 percent changeover the period. However; while screening the wealth quintiles, TFR exhibits declining trend at all levels i.e. from poorest status (4.27-4.19 births) to richest standings (3.28-3.05 births per woman). Since, the anticipated number of children rise with woman's age (6.62-6.17 births) projected for the age cohort 45-49 contrasted to (0.65-0.51 births) for age cohort (15-19). Number of births varies negatively by means of educational attainment of women; approximately 3.6-2.2 births for women having 10 years or above level of education in contrasted to 5.70-4.4 births for women with no education. It means that mostly women who continue their education; usually have preferences for marrying late in their lives. Unexpectedly, working women is linked by means of increased fertility (4.39-4.1 births) as compares to (4.09-3.6 births) among non-working women. Outcomes negated the expected hypothesis that working women probable to decrease TFR by practicing more birth control tools (contraceptives). This may be due to the reality that women who receive their payments in kind not in cash are more expected to be uneducated, deprived and leading a subservient life under cultural standards and patriarchy system that leads to high fertility among working women (Sheikh, et al. 2017). Findings revealed that highly educated men prefer to marry with well-educated women and this more often than not happened at grown-up age. Women, married men with no education are linked to high fertility (4.43 births) in contrasted to 3.32-3.06 births of husbands with higher education.

4.2 Fertility Inhibiting Effects of Proximate Determinants

4.2.1 Multiplicative Model of Total Fertility Rate (TFR) (Aggregated Level)

Estimated values of five indices for different time points are presented in fig. 02. Contribution of each index signifies the proportionate decline in fertility attributed to the fertility determinant. Table 04 reports that calculated values of TFR are 5.4, 4.1 and 3.8 children per woman during 1991, 2007 and 2013, respectively. Regarding the fertility differentials between residences, rural women report one child more on average than urban women. TFR values for rural women are 5.6, 4.5 and 4.2 while 4.9, 3.3 and 3.2 children per woman for urban women in 1991, 2007 and 2013, respectively. Rural women may desire bigger families to guarantee that children will assist households and farming activities and also offer some economic security in older age. Urban women may limit their fertility due to the cost related to childbearing and nurturing. In 1990-91, across four Provinces, TFR (est.) was found minimum in Sindh (5.1) and maximum in Balochistan (5.8 live births per woman). In

2006-07, Sindh and Khyber Pakhtunkhwa showed higher (4.3) and Punjab showed lower TFR i.e. 3.9 children per woman. In 2012-13, TFR is found lowest in Islamabad and again higher in the under privileged areas of Balochistan i.e. 3 and 4.2 children per woman, respectively.

4.2.2 Proximate Determinants of Fertility (Disaggregated Level)

4.2.2.1 Index of Marriage (C_m)

Index of marriage measures the inhibiting effect of marriage patterns on fertility and came out as the second primary contributing factor in declining fertility. Calculated values of (C_m) for total women are 0.748 (1991), 0.741 (2007) and 0.759 (2013), decreases the actual fertility level below the marital fertility by 25, 25.9 and 24 percent, respectively. Index values are found higher for rural residence (0.759, 0.751 and 0.754) as compared to urban (0.755, 0.722 and 0.713) which shows that C_m have more fertility inhibiting effects on urban women (24.5, 27.8 and 28.7 percent) in contrast to rural women (24.1, 24.9 and 24.6 percent).. Noticeably, marriage index constantly shows a considerable decreasing trend for all geographic regions. In 1991, calculated value is smallest for Sindh (0.706) and highest for Khyber Pakhtunkhwa (0.757) accounted for 29.4 and 24.3 percent reduction in fertility. In 2007, estimated value found lowest in Balochistan (0.639) and highest in Sindh (0.762) while during 2012-13, value is lowest for Islamabad (0.589) followed by Balochistan (0.705) and highest for Sindh (0.737). It indicates that 36.1 and 23.8 percent of fertility reduction by married women in Balochistan and Sindh, while 41.1, 29.5 and 26.3 percent in Islamabad, Balochistan and Sindh Provinces, respectively.

4.2.2.2 Index of Contraceptive Use (C_c)

Index of contraception (C_c) is intended to gauge the consequence of contraception for decreasing the risk of conception. During 1990s, C_c remained the least contributing factor in reducing fertility but afterwards showed more involvement. Higher contraceptive use leads to a lower index value of contraception. Thus, estimated values of (C_c) for total women are 0.898, 0.749 and 0.706, signifying that 10.2, 25.1 and 29.4 percent of fertility of married fertile women has been controlled by the contraceptive use over the period. Calculated values of C_c found higher in rural areas (0.947, 0.794 and 0.821) than urban (0.785, 0.661 and 0.64). Uptake of contraception reduces TFR by 21.5 (1991), 33.9 (2007) and 36 (2013) percent in urban areas, indicating that married women in urban areas are more likely to practice modern contraception due to higher levels of education and easy accessibility to medical centers. Across regions, effect of contraceptive use among currently married women is highest in Islamabad (0.530) followed by Punjab (0.668), accounting for 47 and 33.2 percent reduction in TFR while Balochistan (0.853) remained a weak user for adopting contraception technology during 2013. Many researchers argued that social acceptability of adopting family planning measures plays a significant role in determining whether a woman practice contraception (Casterline, et. al 2001; Stephenson, 2004). Generally, disapproval by husband and religious resistance by sacred leaders are mentioned as the two common characteristics of social acceptability of contraception use for limiting family size (Mahmood, et al. 1996; Nasir, 2011; Mir, et al. 2013).

Another foremost clarification for the less use of modern contraceptive methods is focused on women's status, a strong preference for sons (Hussain, et. al 2000), or else the relationship among women's empowerment and mobility of freedom and contraceptive practice (Sathar, 1997; Saleem, 2005; Mumtaz, 2005). Many studies discover the apprehension of side effects and health related concerns to be a key barrier in practicing modern contraceptive methods (Hashmi, et. al 1993; Nishtar, et. al 2013).

4.2.2.3 Index of Induced Abortion (C_a)

Index of induced abortion shows minor role in fertility reduction. Calculated index values of C_a for total women are 0.786 (1991), 0.718 (2007) and 0.685 (2013) stating approximately 21.4, 28.2 and 31.5 percent inhibitory effect on TFR. Index values show slight difference among urban and rural areas because the projected values for urban women are 0.737, 0.661 and 0.672 that contribute somewhat more in fertility cut by 26.3, 33.9 and 32.8 percent than rural women (0.791, 0.749 and 0.668) over the period. During 1990s, induced abortion played comparatively less role in fertility reduction in all geographic stratums. In 2007, C_a found lowest in Khyber Pakhtunkhwa (0.724) and highest in Balochistan (0.745) accounting for 27.4 and 25.5 percent fertility reduction. In 2013, C_a shows lack of induced abortions in Islamabad since the estimated value equals to 0.858 (14.2 percent) while minimum in Khyber Pakhtunkhwa (0.696) that contributes 29.4 percent decrease in TFR due to abortions.

4.2.2.4 Index of Postpartum Infecundability (C_i)

Lactation has an inhibitory effect on ovulation and therefore, increases birth interval and decreases fertility level naturally. The strongest and the most powerful inhibitory effect on fertility are reported by the index of postpartum Infecundability since 1990. For total women, index values are 0.642, 0.653 and 0.656 indicating a stronger average estimated effect on fertility reduction i.e. 35.8, 34.7 and 34.4 percent, over the period. It is interesting to note that C_i inhibits fertility of rural women more than urban women due to lengthy median duration of amenorrhea that results in longer period of insusceptibility. The estimated values of C_i for rural and urban women are 0.629, 0.648, 0.645 and 0.707, 0.664, 0.662 that leads to a substantial decrease in fertility by 37.1, 35.2, and 35.5 in rural while 30, 33.6 and 33.8 percent in urban areas over the period. Across geographic stratums, maximum inhibiting effect of C_i is observed in Khyber Pakhtunkhwa 0.608 (1991), 0.624 (2007) and 0.629 (2013) due to lengthy period of postpartum amenorrhea while minimum in Punjab 0.664 (1991), 0.666 (2007). Islamabad showed the highest value of index i.e. 0.711, representing relatively shorter duration of breastfeeding.

4.2.2.5 Index of Primary Sterility (C_p)

Index of primary sterility remained the least contributing factor in reducing fertility. Calculated index values vary little from region to region and equals to and greater than 1, implying that primary sterility is very rare and shows negligible inhibiting effects. However, sterility holds considerable social impacts for women in many developing countries; where childbearing is a predictable task and responsibility of a woman. Community usually disgraces countenanced by women who are not capable to get pregnant must not be undervalued. So, as sterility is not estimated to have great suggestions by means of fertility transition, from a policy point of view, treatment for sterility may be thought in future health investments.

4.3 Contribution of Proximate Determinants of Fertility

4.3.1 Relative Contribution (Percentage Reduction)

Table 05 displays that total 100 percent live births had restricted over the period due to four major PDs of fertility. In all geographic stratums, calculated index value of C_p is ≥ 1 (Log 1=0), thus, it is excluded from the measurement of relative/absolute contributions. Figure 03 shows that marriage pattern inhibited 26.76, 21.33 and 19.35 percent live births, contraception 9.80, 21.33 and 24.15 percent, induced abortion 21.93, 25.40 and 27.20 percent and postpartum infecundability 41.51, 31.94 and 29.30 percent live births, respectively. After 1990s, family planning methods occupied its independence and had appeared as a key factor of fertility change. Effects of contraception are also increased after 1990s, meantime, abortion (it is be supposed to be discouraged religiously/culturally, as it might break down the family development or might be unsafe for women's reproductive health) showed better recital in reducing fertility (Spoorenberg, 2009). During the mentioned period, total 100 percent live births have constrained in rural and urban areas. Marriage pattern inhibited 23.79, 21.26 and 21.34 percent, contraception 20.43, 26.89 and 27.81 percent, induced abortion 26.10, 26.89 and 24.96 percent, and postpartum infecundability 29.68, 26.89 and 25.89 percent live births in urban whereas 27.75, 21.30 and 21.84 percent, 4.95, 19.21 and 15.06 percent, 22.74, 26.78 and 30.40 percent, 44.57, 35.11 and 32.70 percent births are inhibited in rural areas due to marriage, contraception, induced abortion and postpartum infecundability, respectively. Relative contributions of postpartum infecundability followed by marriage are found higher for rural women than their urban counterpart. Probably, rural women are more likely to attach with traditional practice of breastfeeding for a longer period or due to their likelihood to be in informal employment, therefore, have sufficient time to breastfeed their children. In addition, their children are more expected to be with them even when they are working (Tutu, 2008). Relative contribution of contraception found higher in urban than rural areas. Difference perhaps reflects the inadequate availability of family planning services in rural areas, and may be due to disparities in the levels of use rather than effectiveness of method. Furthermore, it could be due to the increase educational attainment or high knowledge and higher practice for the acceptance of contraception in the urban than the rural areas. Among all Provinces, in Khyber Pakhtunkhwa and Balochistan, relative contribution of postpartum infecundability found higher i.e. 47.05 and 48.50 percent (1991), 37.39 and 34.84 percent (2007) and 33.44 and 32.96 percent (2013). This may be due to the reason that women in Khyber Pakhtunkhwa and Balochistan are more likely to breastfed their young ones due to prevailing customs and traditions while the women in Islamabad (20.68 percent) are less likely to increase the duration of lactation owing to the job responsibilities in formal sectors. The contribution of abortion (pregnancy loss whether the pregnancy ended in a miscarriage, an induced abortion, or a stillbirth) found slightly higher among rural women. Perhaps, rural women's insufficient intake of micro-nutrients during pregnancy results in higher abortions than urban counterparts. As sufficient micro-nutrient intake by women during pregnancy provides vital benefits to both women and children. Vitamin A and iron supplements shields the mother and infant against anemia, which is considered a major cause of perinatal[19] and maternal mortality. Anemia also results in an increased risk of premature delivery and low birth weight. Additionally, iodine deficiency is linked to a number of unpleasant pregnancy outcomes including abortion, fetal brain damage and innate malformation, stillbirth, and prenatal death. Balochistan reports 25.82 and 28.39 percent (2007 and 2013) high abortions as compared to other regions. The reasons might be the prevailing orthodoxy society, male supremacy; low levels of literacy rate and poor health facilities results in miscarriages, abortions and still births.

4.3.2 Absolute Contribution

Table 06 shows the magnitude of inhibiting effects being accounted for by each proximate determinant of fertility at different time points. Fig. 04 indicates that a total of 9.94, 11.20 and 11.50 live births being inhibited: 2.66, 2.39 and 2.23 live births are due to effect of marriage pattern; 0.97, 2.39 and 2.78 due to contraception, 2.18, 2.84 and 2.78 due to abortions and 4.13, 3.58 and 3.37 due to postpartum infecundability over the time period. A total of 10.40, 12 and 12.10 live births in urban while 9.72, 10.80 and 11.10 births being inhibited in rural areas over the time period, respectively. Marriage pattern inhibits 2.47, 2.50 and 2.58 live births in urban whereas 2.70, 2.25 and 2.42 births in rural areas; followed by contraception practice (2.12, 3.17 and 3.37 children) in urban and 0.48, 2.03 and 1.67 children per woman in rural areas from 1990 to 2013, respectively. After 1990, contribution of induced abortions increased at slow pace to trim down the fertility in both rural and urban regions. Oppositely, effects of postpartum infecundability are more profound in fertility reduction among rural woman i.e. 4.33 (1991), 3.70 (2007) and 3.63 children (2013) than urban women, 3.09, 3.17 and 3.13 births per woman. Absolute change in Khyber Pakhtunkhwa is remarkable to note down: a total of 9.80 and 11.40 births are inhibited due to marriage (2.56 and 42.60) followed by postpartum infecundability (4.61 and 3.81 births) between 1990 and 2013. Likewise, a total of 12.30 live births are inhibited in Islamabad: marriage inhibited 3.92 births, contraception 4.72 births, 1.12 births due to induced abortions and 2.54 births due to postpartum infecundability in 2013.

4.4 Synthetic Transition in the Proximate Determinants of Fertility in Pakistan

Bongaarts and Potter (1983) used PDs model to categorize population into one of the four stages of "synthetic transition"[20]. Each one defined by well-matched levels of PDs that would change the

[22] Pertaining to the period immediately before and after birth
[23]Group of population with TFR values of children per woman
Phase 1: > 6
Phase II: 4.5- 6
Phase III: 3- 4

transition from a natural fertility level to a regulated one definitely noticeable by high pervasiveness levels. To identify recent position of Pakistan regarding the aforementioned synthetic transition phases of fertility, related estimated measures are compared with Bongaarts calculated measures (Table 07). CPR is about 10 percent less than countries falling in phase III whereas, 2.85 more than countries falling in stage II. Average contraceptive use-effectiveness is 10.58 and 11.62 percent less effective as compared to the nations in phase II and III, respectively. TAR is relatively much higher than the calculated values of Bongaarts for four stages. Mean duration of postpartum infecundability is almost 43.65 percent more than countries in phase III and 5.35 percent less than developing countries falling in phase I. combined fertility inhibiting effect of the PDs are also very close to stage III transition in all regions. Even though, index of marriage to some extent is higher than that of phase III but close to phase II transition. Index values of contraceptive use lies in between stage II and III while the calculated value of induced abortion belongs to the III and IV synthetic phase of fertility transition. TFR of Pakistan as well as for all geographic stratums is very close to the fertility situation of synthetic phase III, which have gone distant apart from natural fertility level to highly controlled regulated fertility stage. On the whole, estimated TMFR is about 30.80 percent while TNMFR is approximately 13.45 percent lower as compared to the countries believed in phase III transition. Regional analysis confirms that presently PDs of every region has fallen in the stage III of synthetic transition excepting the indices of marriage and contraceptive use. Fertility measures, CPR and contraceptive use-effectiveness place some regions in stage II and III.

5 CONCLUSIONS AND RECOMMENDATIONS

The findings exhibit that postpartum infecundability is the strongest and powerful inhibitory factor of fertility followed by marriage pattern. It is remarkable to note that the postpartum infecundability slows down the fertility of rural women more than urban women due to the prolonged median duration of lactation and abstinence. A disaggregation of the marriage factor illustrates that late marriage in urban areas has larger impact on TFR than early marriages in rural areas. When comparing the effects of indices among regions, the postpartum infecundability is the foremost inhibitory factor in Sindh, Khyber Pakhtunkhwa, Balochistan and Gilgit Baltistan while marriage has shown higher fertility reduction in Punjab and Islamabad. Contraception and induced abortion remained the less contributing factors in controlling TFR in early 1990s but increasing participation are being observed steadily afterwards; while the primary sterility stayed behind the least contributing factor in declining fertility in all regions. National as well as regional analysis confirmed that Pakistan and its all regions as have entered in the stage III (early phase) of synthetic transition of fertility. From the results, it seems quite obvious that Bongaarts model could be an efficient and useful tool in controlling the mammoth of population. This study suggests that in prevailing traditional, socio-cultural and orthodoxy society; open consultation regarding the

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Phase IV: <3

appalling effect of early marriages (especially in rural areas), reproductive health and contraceptive practice should be encouraged by raising women's education and family planning services. Moreover; couples should also be encouraged for sterilization after achieving desired family size for limiting fertility. It is also recommended that special programs should be implemented to encourage women regarding breastfeeding practice and publicize its enormous benefits for mother's and child's health in long term will help in combating fertility in Pakistan.

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Table 01 Estimated use effectiveness by contraceptive method e(m) for most developing countries

Method	**Estimated use effectiveness e(m)**
Sterilization (male and female)	1.0
IUD	0.95
Pill	0.9
Injectable	0.9
Male Condom	0.7
Other modern method	0.7
Traditional	0.5
Total	**5.65**

Source: Bongaarts, 1982

Table 02 Relative percentages of Age Specific Fertility Rates (ASFR) per 1000 women and Total Fertility Rates (TFR), Pakistan 1990-2013

Geographic Stratums (Time)	TFR	Age Groups of Married Women													
		15-19		20-24		25-29		30-34		35-39		40-44		45-49	
Total		ASFR	%	ASFR	%	ASFR	%	ASFR	%	ASFR	%	ASFR	%	ASFR	%
1990-91	5.4	84	7.8	230	21.5	268	25	229	21.4	147	13.7	73	6.8	40	3.7
2006-07	4.1	64	7.0	210	22.9	246	26.8	205	22.3	119	12.9	52	5.6	24	2.6
2012-13	3.8	44	4.6	190	15.9	224	20.6	181	19	91	16.5	30	12.5	7.0	11.0
% change 1990-2013	**-29.6**	**-47.6**	**-41.0**	**-17.4**	**-26.0**	**-16.4**	**-17.6**	**-21.0**	**-11.2**	**-38.1**	**20.4**	**-58.9**	**83.8**	**-82.5**	**197.3**
Place of Residence															
Urban															
1990-91	4.9	59	6.0	224	22.9	268	27.3	225	23.0	126	12.9	49	5.0	29	3.0
2006-07	3.3	43	5.3	193	23.9	235	29.1	192	23.8	94	11.6	35	4.3	16	1.9
2012-13	3.2	27	3.4	161	13.0	201	19.9	158	18.0	61	17.6	21	14.8	2	13.4
% change 1990-2013	**-34.7**	**-54.2**	**-43.3**	**-28.1**	**-43.2**	**-25.0**	**-27.1**	**-29.8**	**-21.7**	**-51.6**	**36.4**	**-57.1**	**196.0**	**-93.1**	**346.7**
Rural															
1990-91	5.6	97	8.7	235	21.0	268	24.0	231	15.8	157	14.1	85	7.6	44	3.9
2006-07	4.5	75	7.7	221	22.5	252	25.8	212	21.7	132	13.5	60	6.1	27	2.8
2012-13	4.2	53	4.9	206	17.0	236	20.3	193	18.0	107	16.4	35	12.1	10	11.5
% change 1990-2013	**-25.0**	**-45.4**	**-43.7**	**-12.3**	**-19.0**	**-11.9**	**-15.4**	**-16.5**	**13.9**	**-31.8**	**16.3**	**-58.8**	**59.2**	**-77.3**	**194.9**
Regions															
Punjab															
1990-91	5.4	79	7.3	226	21	275	25.6	237	22.0	159	14.8	70	6.5	30	2.8
2006-07	3.9	60	6.6	210	22.9	256	28.0	209	22.8	117	12.8	47	5.1	17	1.9
2012-13	3.8	41	5.4	194	25.7	237	31.4	181	24.0	75	9.9	24	3.2	3	0.4
% change 1990-2013	**-29.6**	**-48.1**	**-26.0**	**-14.2**	**22.4**	**-13.8**	**22.7**	**-23.6**	**9.1**	**-52.8**	**-33.1**	**-65.7**	**-50.8**	**-90.0**	**-85.7**
Sindh															

1990-91	5.1	88	8.6	235	22.9	242	23.6	211	20.6	118	11.5	79	7.7	51	5
2006-07	4.3	66	7.3	211	23.4	222	24.6	200	22.1	118	13.1	57	6.3	32	3.5
2012-13	3.9	43	5.5	186	23.8	201	25.7	189	24.2	117	15.0	34	4.3	12	1.5
% change 1990-2013	**-23.5**	**-51.1**	**-36.0**	**-20.9**	**3.9**	**-16.9**	**8.9**	**-10.4**	**17.5**	**-0.8**	**30.4**	**-57.0**	**-44.2**	**-76.5**	**-70.0**
Khyber Pakhtunkhwa															
1990-91	5.5	86	7.8	227	20.6	287	26.1	233	21.2	149	13.5	77	7	41	3.7
2006-07	4.3	74	8	204	22.1	247	26.7	203	22	130	14.1	41	4.4	26	2.8
2012-13	3.9	62	8.3	181	24.2	206	27.5	173	23.1	111	14.8	4	0.5	11	1.5
% change 1990-2013	**-29.1**	**-27.9**	**6.4**	**-20.3**	**17.5**	**-28.2**	**5.4**	**-25.8**	**9.0**	**-25.5**	**9.6**	**-94.8**	**-92.9**	**-73.2**	**-59.5**
Balochistan															
1990-91	5.8	149	14.1	267	25.3	251	23.8	190	18.0	116	11.0	82	7.8	6	0.6
2006-07	4.1	99	10.4	233	24.5	244	25.7	176	18.5	114	12.0	74	7.8	15	1.3
2012-13	4.2	48	5.7	198	23.4	236	27.9	162	19.2	111	13.1	66	7.8	24	2.8
% change 1990-2013	**-27.6**	**-67.8**	**-59.6**	**-25.8**	**-7.5**	**-6.0**	**17.2**	**-14.7**	**6.7**	**-4.3**	**19.1**	**-19.5**	**0.0**	**300.0**	**366.7**
Islamabad															
1990-91	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2006-07	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2012-13	3.0	25	4.3	124	21.1	221	37.6	149	25.3	68	11.6	1	0.2	0	0
Gilgit Baltistan															
1990-91	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2006-07	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2012-13	3.8	54	7.1	174	22.7	208	27.2	172	22.5	107	14.0	37	4.8	13	1.7

Source: *Author's compilation of Pakistan Demographic and Health Surveys data (1990-91, 2006-07 and 2012-13)*

Table 03 Percentage distribution of some selected socio-economic factors by Total Fertility Rates and their change over the period 1990-2013, Pakistan

Socio-economic Characteristic	**Total Fertility Rate (TFR)**			
	1990-91	2006-07	2012-13	% change between 1990 and 2013
Place of Residence				
Urban	4.90	3.30	3.20	-34.69
Rural	5.60	4.50	4.20	-25.00
Regions				
Punjab	5.40	3.90	3.80	-29.63
Sindh	5.10	4.30	3.90	-23.53
Khyber Pakhtunkhwa	5.50	4.30	3.90	-29.09
Balochistan	5.80	4.10	4.20	-27.59
Islamabad	---	---	3.00	---
Gilgit Baltistan	---	---	3.80	---
Wealth Quintiles				
Poorest	---	4.27	4.19	---
Poorer	---	4.10	4.00	---
Middle	---	4.09	3.89	---
Richer	---	3.85	3.52	---
Richest	---	3.28	3.05	---
Women's Age Cohorts				
15-19	0.65	0.52	0.51	-21.54
20-24	1.69	1.49	1.36	-19.53
25-29	3.15	2.71	2.51	-20.32
30-34	4.59	4.12	3.81	-16.99
35-40	5.66	5.12	4.74	-16.25
40-44	6.38	5.89	5.42	-15.05
45-45	6.62	6.45	6.17	-6.80
Women's Education				
No education	5.70	4.8 0	4.40	-22.80
Primary	4.90	4.00	4.00	-18.36
Secondary	4.50	3.20	3.20	-28.88
Higher	3.60	2.70	2.20	-38.88
Employment Status				
Working	4.39	4.26	4.11	-6.38
Not working	4.09	3.78	3.61	-11.74
Husband's Education				
No education	4.43	4.52	4.49	1.35
Primary	4.40	4.16	3.83	-12.95
Secondary	3.77	3.39	3.37	-10.61
Higher	3.32	3.21	3.06	-7.83
Total	5.40	4.10	3.80	-29.63

Source: *Pakistan Demographic and Health Surveys data (1990-91, 2006-07 and 2012-13)*

Table 04 Estimates of Proximate Determinants of Total Fertility Rate by Bongaarts Model in Pakistan, 1990-2013

Geographic Stratums (Year)	Total Fertility Rate (TFR obs.)	Index of marriage (C_m)	Index of contraceptive use (C_c)	Index of Induced abortion (C_a)	Index of Postpartum Infecundability (C_i)	Index of Primary Sterility (C_p)	Total Fertility Rate (TFR est.)
Total							
1990-91	5.4	0.748	0.899	0.786	0.642	1.03	5.35
2006-07	4.1	0.741	0.749	0.718	0.654	1.03	4.11
2012-13	3.8	0.759	0.706	0.685	0.656	1.03	3.79
Place of Residence							
Urban							
1990-91	4.9	0.755	0.785	0.737	0.707	1.03	4.87
2006-07	3.3	0.722	0.661	0.661	0.665	1.03	3.31
2012-13	3.2	0.713	0.640	0.672	0.662	1.03	3.20
Rural							
1990-91	5.6	0.750	0.948	0.791	0.630	1.03	5.58
2006-07	4.5	0.751	0.795	0.749	0.648	1.03	4.57
2012-13	4.2	0.754	0.821	0.668	0.645	1.03	4.20
Regions							
Punjab							
1990-91	5.4	0.74	0.889	0.782	0.665	1.03	5.39
2006-07	3.9	0.704	0.726	0.731	0.666	1.03	3.92
2012-13	3.8	0.728	0.668	0.739	0.671	1.03	3.80
Sindh							
1990-91	5.1	0.706	0.898	0.835	0.610	1.03	5.09
2006-07	4.3	0.762	0.767	0.732	0.638	1.03	4.30
2012-13	3.9	0.737	0.741	0.715	0.634	1.03	3.90
Khyber Pakhtunkhwa							
1990-91	5.5	0.757	0.919	0.822	0.608	1.03	5.48
2006-07	4.3	0.760	0.794	0.724	0.624	1.03	4.30
2012-13	3.9	0.727	0.778	0.696	0.629	1.03	3.90
Balochistan							
1990-91	5.8	0.737	0.980	0.825	0.620	1.03	5.82
2006-07	4.1	0.639	0.860	0.745	0.630	1.03	4.06
2012-13	4.2	0.705	0.853	0.687	0.645	1.03	4.20
Islamabad							
1990-91	---	---	---	---	---	---	---
2006-07	---	---	---	---	---	---	---
2012-13	3.0	0.589	0.530	0.858	0.71	1.03	3.00
Gilgit Baltistan							

1990-91	---	---	---	---	---	---	---
2006-07	---	---	---	---	---	---	---
2012-13	3.8	0.707	0.695	0.769	0.64	1.03	3.81

Source: *Author's compilation of Pakistan Demographic and Health Surveys data (1990-91, 2006-07 and 2012-13)*

Table 05 Trends of total fertility inhibiting effect for each proximate determinant, the relative contribution (Percent Reduction) by Bongaarts model in Pakistan, 1990-2013

Geographic Stratums (Time)	Effect of C_m	Effect of C_c	Effect of C_a	Effect of C_i	TF-TFR (est.)
Total					
1990-91	26.76	9.80	21.93	41.51	100.00
2006-07	21.33	21.33	25.40	31.94	100.00
2012-13	19.35	24.15	27.20	29.30	100.00
Urban					
1990-91	23.79	20.43	26.10	29.68	100.00
2006-07	21.26	26.89	26.89	26.89	100.00
2012-13	21.34	27.81	24.96	25.89	100.00
Rural					
1990-91	27.75	4.95	22.74	44.57	100.00
2006-07	21.30	19.21	26.78	35.11	100.00
2012-13	21.84	15.06	30.40	32.70	100.00
Punjab					
1990-91	27.84	10.77	22.97	38.42	100.00
2006-07	26.28	23.19	23.19	29.51	100.00
2012-13	22.21	28.27	21.25	28.27	100.00
Sindh					
1990-91	30.35	9.34	16.51	43.80	100.00
2006-07	30.55	20.71	15.72	35.36	100.00
2012-13	21.40	21.40	24.35	32.84	100.00
Khyber Pakhtunkhwa					
1990-91	26.12	7.94	18.89	48.93	100.00
2006-07	29.03	18.44	17.45	37.39	100.00
2012-13	22.77	17.98	25.81	33.44	100.00
Balochistan					
1990-91	30.55	2.05	18.90	48.50	100.00
2006-07	30.20	11.37	25.82	34.84	100.00
2012-13	26.21	12.44	28.39	32.96	100.00
Islamabad					
1990-91	---	---	---	---	
2006-07	---	---	---	---	
2012-13	31.87	38.34	9.11	20.68	100.00
Gilgit Baltistan					

1990-91	---	---	---	---	
2006-07	---	---	---	---	
2012-13	24.35	25.35	18.58	31.72	100.00

Source: *Author's compilation of Pakistan Demographic and Health Surveys data (1990-91, 2006-07 and 2012-13)*

Table 06 Trends of total fertility inhibiting effect for each proximate determinant, the Absolute Contribution by Bongaarts model in Pakistan, 1990-2013

Geographic Stratums (Time)	Effect of C_m	Effect of C_c	Effect of C_a	Effect of C_i	TF-TFR (est.)
Total					
1990-91	2.66	0.97	2.18	4.13	9.94
2006-07	2.39	2.39	2.84	3.58	11.20
2012-13	2.23	2.78	3.13	3.37	11.50
Urban					
1990-91	2.47	2.12	2.71	3.09	10.40
2006-07	2.50	3.17	3.17	3.17	12.00
2012-13	2.58	3.37	3.02	3.13	12.10
Rural					
1990-91	2.70	0.48	2.21	4.33	9.72
2006-07	2.25	2.03	2.82	3.70	10.80
2012-13	2.42	1.67	3.37	3.63	11.10
Punjab					
1990-91	2.76	1.07	2.28	3.81	9.91
2006-07	2.93	2.59	2.59	3.29	11.40
2012-13	2.55	3.25	2.44	3.25	11.50
Sindh					
1990-91	3.09	0.95	1.68	4.46	10.18
2006-07	3.28	2.23	1.69	3.80	11.00
2012-13	2.44	2.44	2.78	3.74	11.40
Khyber Pakhtunkhwa					
1990-91	2.56	0.78	1.85	4.61	9.80
2006-07	3.12	1.98	1.88	4.02	11.00
2012-13	2.60	2.05	2.94	3.81	11.40
Balochistan					
1990-91	2.89	0.19	1.788	4.58	9.46
2006-07	3.31	1.25	2.83	3.82	11.20
2012-13	2.91	1.38	3.15	3.66	11.10
Islamabad					
1990-91	---	---	---	---	---
2006-07	---	---	---	---	---
2012-13	3.92	4.72	1.12	2.54	12.30
Gilgit Baltistan					---

1990-91	---	---	---	---	
2006-07	---	---	---	---	---
2012-13	2.80	2.92	2.14	3.65	11.50

Source: *Author's compilation of Pakistan Demographic and Health Surveys data (1990-91, 2006-07 and 2012-13)*

Table 07 Measures of proximate determinants of fertility and four phase of synthetic transition, Pakistan, 2012-13

Measures of Fertility	Synthetic phases of fertility transition				Total	Urban	Rural	Punjab	Sindh	KPK[1]	BC[2]	ICT[3]	GB[4]
	I	**II**	**III**	**IV**	**III**	**III**	**III**	**III**	**III**	**III**	**III**	**III**	**III**
Contraceptive prevalence rate (u)	0.10	0.35	0.40	0.69	0.36	0.45	0.23	0.41	0.30	0.28	0.17	0.60	0.34
Contraceptive use-effectiveness (e)	0.85	0.85	0.86	0.94	0.76	0.74	0.71	0.75	0.81	0.73	0.78	0.73	0.84
Total induced abortion rate (TAR)	0.00	0.00	0.38	0.46	3.22	2.69	4.25	2.38	2.99	3.33	4.09	0.78	2.14
Mean postpartum infecundability (i)	12.9	7.6	8.50	3.00	12.21	11.83	13.02	11.25	13.88	14.22	13.02	8.88	13.45
Proximate Determinants of fertility													
Index of marriage (C_m)	0.78	0.63	0.55	0.55	0.76	0.71	0.75	0.73	0.74	0.73	0.71	0.59	0.71
Index of contraceptive use (C_c)	0.91	0.69	0.63	0.30	0.70	0.64	0.82	0.67	0.74	0.78	0.85	0.53	0.70
Index of Induced abortion (C_a)	1.00	1.00	0.96	0.89	0.68	0.67	0.67	0.74	0.71	0.70	0.69	0.86	0.77
Index of Postpartum Infecundability (C_i)	0.65	0.78	0.76	0.93	0.66	0.65	0.67	0.67	0.63	0.63	0.65	0.71	0.64
Combined inhibiting effect ($C_m \times C_c \times C_a \times C_i$)	0.47	0.33	0.26	0.15	0.24	0.20	0.27	0.24	0.25	0.25	0.27	0.19	0.25
Total Fertility Rate (TFR)	7.03	5.03	3.88	2.06	3.8	3.2	4.2	3.8	3.9	3.9	4.2	3.0	3.8
Total Marital Fertility Rate (TMFR)	9.08	8.08	7.05	3.80	4.88	4.33	5.46	5.08	5.06	5.26	5.83	4.95	5.28
Total Natural Marital Fertility Rate (TNMFR)	9.93	11.93	11.67	14.23	10.10	10.10	9.95	10.25	9.64	9.64	9.95	10.86	9.79

Source: Bongaarts and Potter (1983)

[1] Khyber Pakhtunkhwa
[2] Balochistan
[3] Islamabad
[4] Gilgit Baltistan

Figure 01 Trends in women's age pattern of fertility in Pakistan, 1990-2013

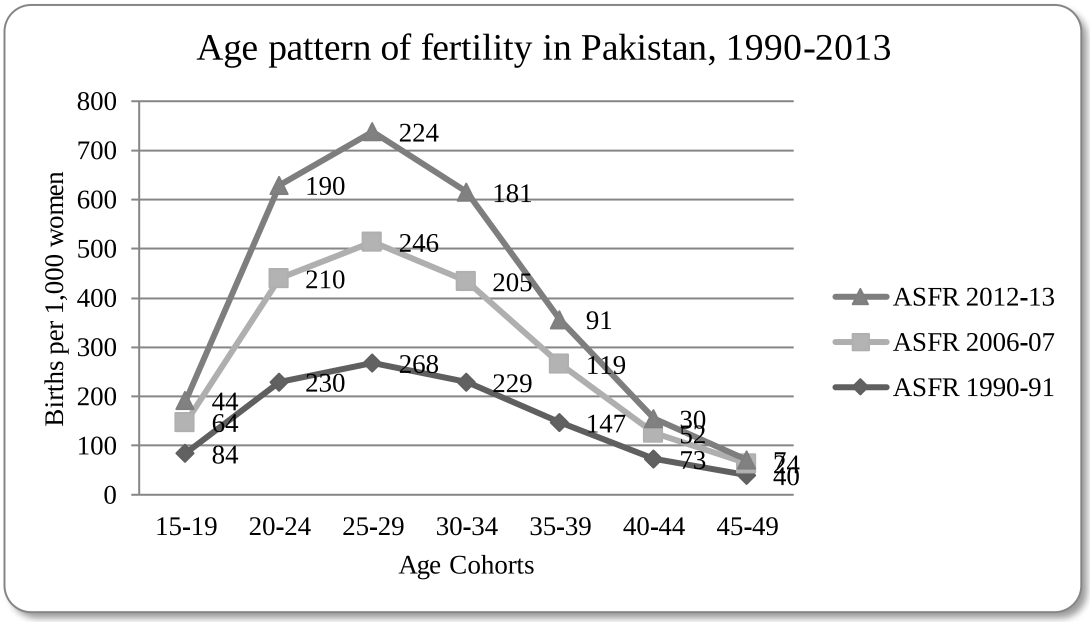

Figure 02 Inhibiting Effects of Proximate Determinants Of Fertility by Bongaarts Model in Pakistan, 1990-2013

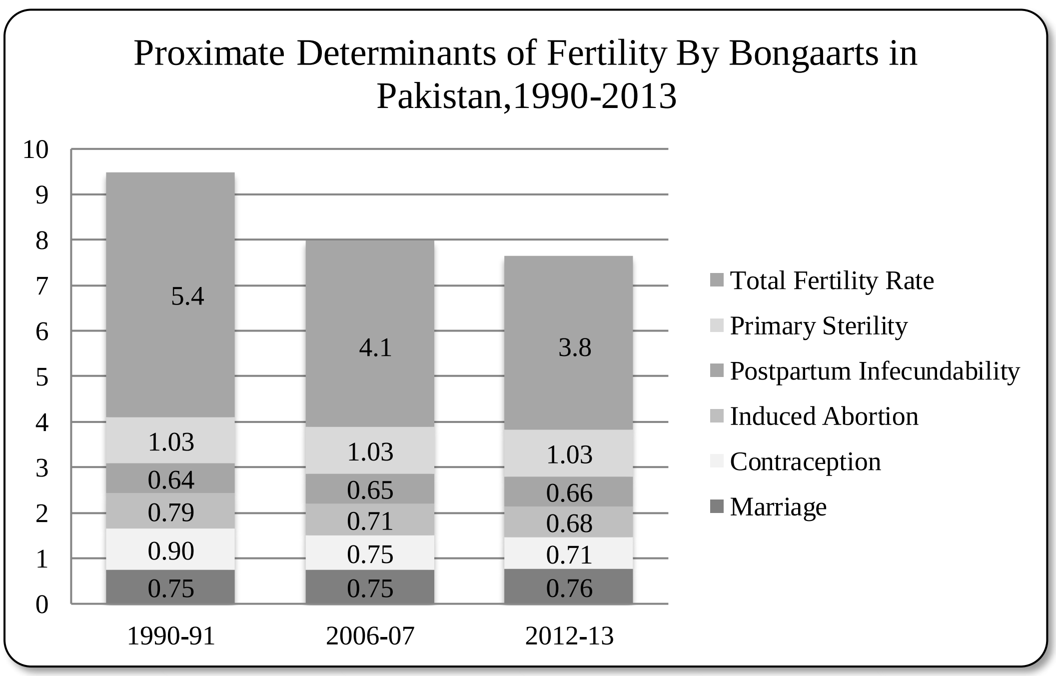

Figure 03 The Relative Contribution of Proximate Determinants of fertility by Bongaarts in Pakistan, 1990-2013

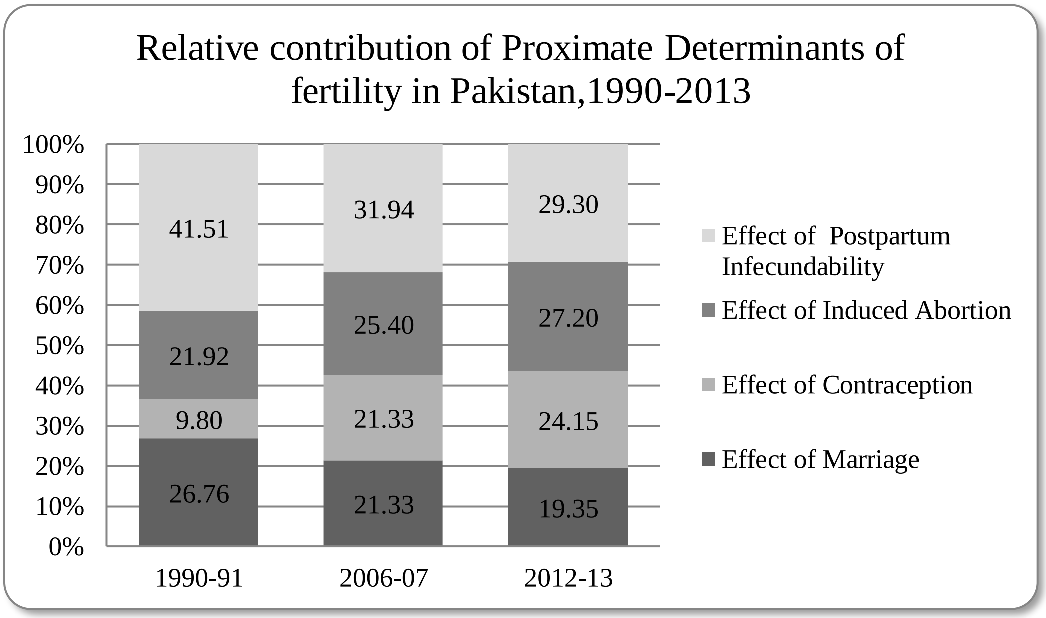

Figure 04 The Absolute Contribution of Proximate Determinants of fertility by Bongaarts in Pakistan, 1990-2013