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LEVELS OF RECENT AND TARGETTED DETERMINANTS OF FERTILITY IN PAKISTAN

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Abstract: The Bongaarts non-age-specific aggregate approach for determining the proximate determinants of fertility have been vogue for over two decades. In this paper, we estimated the proximate determinants of fertility in Pakistan. The data used in this study have been taken from two National Surveys. The marriage index reveals that 68% of Pakistani women in their reproductive period are sexually active while keeping all other determinants constants. The index of contraceptive use and effectiveness indicates that fertility is only 17 % lower than it would be, if no women ever used contraception keeping all other determinants constant. In this study, under the borrowed assumption the index of post-partum fecundibility shows that the post-partum amenorrhea and post-partum abstinence suppress maximum potential fertility is about 35%. Lastly, a contraceptive-method-specific target-setting methodology has been presented for the policy makers using the above proximate determinants of fertility under certain assumptions for estimating the increase in contraceptive prevalence that would have to occur to achieve targeted future reductions in Pakistan's fertility.

***Keywords*:** Bongaarts model; contraceptive; fertility; proximate determinants; total fertility rate.

Introduction

Pakistan is the seventh most populous developing country in the world and has shown a controversial gentle decline in fertility despite a limitedeffortshavebeenmadefortheimprovement [1]. The onset of the fertility decline in Pakistan has engendered much interest since it has been suggested that Pakistan's fertility transition is controversial in certain important respects. Demographically fertility behaviour is changing over time [2,3]. The assessment of fertility behaviour is based on certain measures. These standard fertility measures are mostly estimated from censuses or surveys data. One such measure is total fertility rate (TFR) that is considered to be refined and reliable measure of fertility in a population and is interpretable as the number of children that a woman would have during her lifetime if she were exposed to the age-specific fertility rates prevailing in a population in a given period [4]. Controversies exist on the fertility transition in Pakistan and remain an active area in research among the demographers and the policy makers, to understand the key determinants of fertility. Numerous fertility surveys indicate that the TFR in Pakistan remained above 6.0 births per woman through out the 1980s (See Table 1).

Table 1: Estimates of Total Fertility Rates in Pakistan during 1980s - 2000s.

Decade	Source	TFR
1980s	Pakistan Contraceptive prevalence Survey (1984-85)	6.0
	Pakistan Demographic Survey (1984-88)	6.9
	Pakistan Demographic and Health Survey (1990-91)	5.4
1990s	Pakistan Demographic Survey (1992)	5.8
	Pakistan Contraceptive prevalence Survey (1994-95)	5.6
	Pakistan Fertility and Family Planning Survey (1996-97)	5.3
2000s	Pakistan Reproductive Health and Family Planning Survey (2000-01)	4.8
	Pakistan Demographic Survey (2001)	4.1
	Pakistan Demographic Survey (2003)	3.9
	Pakistan Demographic Survey (2005)	3.8

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In this article, we have tried to find the proximate determinants of fertility through Bongaarts' model [5] using data from two national surveys [6,7]. The main objectives of this study are:

(i) To estimate the TFR through Bongaarts' non-age-specific aggregate model,
(ii) To determine most important proximate determinant of fertility in Pakistan, and
(iii) To present target-setting methodology for estimating the required contraceptive prevalence.

Materials and Methods

Two main sources data were used in this study. These are nationally representative sample surveys; Population Demographic Survey (PDS-2001) and Reproductive Health and Family Planning Survey (PRHFPS-2000-01) of Pakistan. The age specific marital fertility rates have been taken from PDS-2001. In conducting PRHFP survey, a two-stage probability sample design was used. At the first stage, a stratified sample of area units was drawn and at the second stage, a sample of households was selected within that area. Thus, a total of 7332 households were selected, of which 6857 were successfully interviewed. Finally, 7411 ever-married women under the age of 50 years in these households were identified as eligible for the individual interview and the interviews were completed for 6579 or 89% of them. The age-wise proportion of currently married females has been taken from PRHFP survey.

The proximate determinants model

This is a scheme first introduced by Davis and Blake [8] and later modelled by Bongaarts [5] to determine most influential factors affecting fertility. Bongaarts [5] proposed a set of proximate determinants of fertility namely, proportion married among females, prevalence of induced abortion, contraceptive use and effectiveness, duration of post-partum infecundability, fecundability (probability of conception), natural fecundability, spontaneous intra-uterine mortality rate and prevalence of permanent sterility. Out of these, the first four determinants have been considered to exert a strong effect on fertility. In brief, his model is multiplicative in nature and measures TFR as

$$TFR = C_m \text{ x } C_i \text{ x } C_a \text{ x } C_c \text{ x } \boldsymbol{F} \qquad (3.1)$$

where C_m, C_i, C_a, and C_c denote the indices of proportion married, lactational infecundability, abortion and contraception, respectively. The theoretical maximum fertility of a woman is 35 births, not counting multiple births. This theoretical maximum is based on the maximum reproductive life span of age 15 to 50 and the absence of all biological and behavioral constraints. If the constraints waiting time to conception, risk of intrauterine mortality and onset of permanent sterility are taken into account, the average potential fertility is about 15.3 children per woman with minor variations in human sub-populations [9]. This potential fertility is referred to as the total fecundity (TF) (simply defined as the expected number of average live births among those women who are sexually active, fecund, non-contracepting and do not breast-feed their children within their reproductive age). These indices range in value from 0 to 1. A variable has no fertility inhibiting effect if the index is 1, and zero if the fertility inhibition is complete by the given intermediate variable.

These indices are computed as follows:

1. Index of proportion married (C_m)

$$C_m = \frac{TFR}{TM} = \frac{\sum m(a) \text{ x } g(a)}{\sum g(a)} \qquad (3.2a)$$

where m(a) is the proportion of currently married females by age a, g(a) is the age specific marital fertility rate (ASMFR), TM is the total marital fertility rate. C_m equals 1 if all women of reproductive age are married and zero in the absence of marriage.

2. Index of contraception (C_c)

$$C_c = 1 - 1.08 \text{ x } e \text{ x } u \tag{3.2b}$$

where e is the average use-effectiveness of contraception and u is the prevalence of current contraceptive use among married women. C_c equals 1 in the absence of contraception and zero if all fecund women use modern effective contraceptives.

3. Index of post-partum infecundability (C_i)

$$C_i = 20/(18.5 + i) \tag{3.2c}$$

where 'i ' represents average duration of post-partum amenorrhea or the mean duration of post-partum infecundability in months. C_i equals 1 in the absence of lactation and post-partum abstinence and zero if the duration of infecundability is infinite.

4. Index of induced abortion (C_a)

$$C_a = \frac{TFR}{TFR + 0.4(1+u)TAR} \tag{3.2d}$$

where TAR is the total abortion rate and the term 0.4(1 + u) is an estimate of the births averted by a single abortion. A modification of this index is suggested by Stover [10] and according to him *u* should be multiplied by e to describe the proportion of women protected by contraception more accurately and hence

$$C_{a'} = \frac{TFR}{TFR + 0.4(1+ue)TAR}$$

where *e* indicates the average use effectiveness of contraception and is measured by $e = \frac{\sum e_m u_m}{u_m}$, where u_m indicates proportion of women using *m*th specific method and e_m refers to the estimates of contraceptive use effectiveness for *m*th method and is estimated as $e_m = 1 - (f_m / f_n)$, f_m indicates *m*th contraceptive method failure rate and f_n is the natural infecundability.

Model for target setting

Bongaarts' [11] proposed model given in equation (3.1) could be used for target setting, if one makes the following assumptions for the period between the base and target years:

(i) No change takes place in the total fecundity rate, so that TF(t) = TF(0), where t refers to the target year and 0 to the base year;
(ii) Induced abortion is absent or negligible, so that $C_a(t) = C_a(0) = 1$;
(iii) Trends in the indexes C_m and C_i compensate one another.

Under these assumptions, by using some simplification we have the following relationship

$$\frac{TFR(t)}{TFR(0)} = \frac{C_c(t)}{C_c(0)} \tag{4.1}$$

which gives the following expression for the proportional reduction in fertility (PRF) between base and target years

$$PRF = 1 - \frac{C_c(t)}{C_c(0)}. \tag{4.2}$$

Using equation (3.2b), (4.2) becomes

$$PRF = 1 - \frac{1 - 1.08u(t)e(t)}{1 - 1.08u(0)e(0)}. \tag{4.3}$$

Rearranging equation (4.3), it becomes

$$u(t) = \frac{1 - (1 - PRF)(1 - 1.08u(0)e(0))}{1.08e(t)}. \tag{4.4}$$

This is the basic model for estimating the prevalence level required to achieve a desired reduction in fertility.

Results and Discussion

For the application of Bongaarts non-age specific aggregate approach, necessary measures of fertility and the estimated indices are given in Table 2. The detailed calculations of proximate determinants of fertility are elaborated in Appendix A. For computing the average use effectiveness '*e*' of contraception, an estimate of annual failure rate of various methods of contraception was not available from this data, so

such information is taken from [12]. The average use-effectiveness was found to be 0.83 (Table 3). An estimate of TAR was 0.05 based on data PRHFPS 2000-01. Taking values of all these indices as mentioned in Table 2, Bongaarts model produced a TFR equal to 4.80. A lower value of an index among the four major indices of Bongaarts model indicated a higher fertility reducing impact. Among these four principal indices, the index of marriage C_m is designed to express the reduction in fertility caused by women not being sexually active throughout their entire reproductive period. Thus a value of C_m=0.68 indicates that 32% of women in their reproductive period are not sexually active. Another way to view this estimate is to say that late marriage, non-marriage and divorced or widowhood together suppresses fertility by about 32%. In a country such as Pakistan, with comparatively low rates of contraceptive use within marriage, these diminutions in exposure to intercourse afforded by delays in the age in marriage have a substantial direct impact on levels of fertility. Contraceptive practice is the intermediate fertility variable, primarily responsible for the wide range in the levels of fertility within marriage [8]. The value of C_c depends on the prevalence of contraceptive as this index is designed to describe the fertility inhibiting effects of contraceptive use. Thus, the value of C_c=0.83 indicates that all fecund women use very little modern contraceptive methods. The estimated value of C_c implies that about 17% of maximum potential fertility has been suppressed by use of family planning methods. This shows that Pakistan is typical high fertility country. Bongaarts [5] says that C_c ranges between 0.80 and 1.00 for countries with a TFR greater than 5. This almost agrees with the results obtained here. The index C_i shows post-partum infecundability that is designed to describe the effects on fertility of extended periods of post-partum amenorrhea. Unfortunately, there are no data with which to calculate the value of the index of C_i. Therefore, in a similar investigation in Bangladesh the value of C_i is borrowed (C_i=0.65) which means that pos-partum amenorrhea and post-partum abstinence suppress maximum potential fertility by about 35% [4]. To explain the induced abortion index C_a, it is argued that the reliable measurements of the prevalence of induced abortion are often lacking [5] but is also well known that induced abortion is practiced in the society of Pakistan. This index is designed to describe the fertility inhibiting effects of induced abortion. In fact, induced abortion is illegal in Pakistan unless undertaken to save the life of the mother. However, the calculated value of 0.99 indicates no support in reduction of fertility but the practice of induced abortion at low level is visible. These indices for the four proximate determinants of fertility together with a TFR of 4.8 give a TF of $4.8/(0.68\times0.83\times0.65\times0.99)\approx13.22$, which is defined as the expected number of live births among those women who are sexually active, fecund, non-contracepting and do not breast feed their children within their reproductive age. Bongaarts [5] suggested a value of TF between 13.0 and 17.0 for different high fertility populations. Therefore, the TF of 13.22 agrees with the range suggested by Bongaarts [5], which adds credibility to the results obtained.

Table 2: Various fertility measures and TFR by Bongaarts model.

		PRHFPS 2000-01
A.	**Reproductive measure**	
	Proportion of Current Contraceptive use	0.28
	Total Abortion Rate (TAR)	0.05
	Contraceptive use Effectiveness	0.83
B.	**Model Indices**	
	C_m	0.68
	C_c	0.83
	C_i	0.65*
	C_a	0.99
	Combined effect of the four indices	0.36
	TF	13.22
	TFR (estimate)	4.80

*Borrowed from [4]

Table 3: Levels of current use of different contraceptive methods and their use effectiveness.

Methods	U_m	Annual Failure Rate	e_m	$U_m e_m$
Pill	0.01	0.07	0.88	0.01
IUD	0.03	0.008	0.98	0.03
Injectable	0.02	0.003	0.99	0.02
Condom	0.05	0.14	0.76	0.04
Withdrawal	0.05	0.19	0.68	0.03

To illustrate the use of equation (4.4) an application to Pakistan is presented, which assumes that contraceptive-method-specific use effectiveness will remain constant between the base and the target years. In the absence of a trend in effectiveness, that is, with e(t) = e(0), the contraceptive prevalence level required to reach the fertility target, u(t), depends on three variables:

(i) the desired reduction in fertility, that is PRF;
(ii) the prevalence in the base year, that is u(0); and
(iii) the effectiveness of the base year e(0).

Table 4 provides targeted estimates of u(t) for different values of PRF, u(0) and e(0). It is evident from Table 4 that with a targeted reduction in TFR of Pakistan, PRF = 0.20. Also, the contraceptive prevalence and effectiveness for the condom is 10 and 76% respectively (u(0)=0.10 and e(0) = 0.76). Then, the targeted contraceptive-prevalence level u(t) for some e(t) is estimated to be 32.40% among the Pakistani women productive age.

Conclusion

The Bongaarts model of the proximate determinants of fertility is one of the most widely used tools in fertility analysis. From the present analysis it appears that Bongaarts model provides an estimate of TFR = 4.80, (which is the period measure of the population's level of fertility) which is almost consistent with the other National Surveys conducted in Pakistan

Table 4: Estimates of contraceptive prevalence required in the target year.

Method Specific Prevalence	**Targeted PRF between base & target year**					
	U(0)	**e(0) = e(t)**	**0.1**	**0.2**	**0.3**	**0.4**
Pill	0.0	0.88	0.105	0.210	0.316	0.421
	0.1		0.195	0.290	0.386	0.481
	0.2		0.285	0.370	0.456	0.541
	0.3		0.375	0.450	0.526	0.601
	0.4		0.465	0.530	0.596	0.661
IUD	0.0	0.98	0.094	0.189	0.283	0.378
	0.1		0.184	0.269	0.353	0.438
	0.2		0.274	0.349	0.423	0.498
	0.3		0.364	0.429	0.493	0.558
	0.4		0.454	0.509	0.563	0.618
Injectable	0.0	0.99	0.094	0.187	0.281	0.374
	0.1		0.184	0.267	0.351	0.434
	0.2		0.274	0.347	0.421	0.494
	0.3		0.364	0.427	0.491	0.554
	0.4		0.454	0.507	0.561	0.614
Condom	0.0	0.76	0.122	0.244	0.365	0.487
	0.1		0.212	0.324	0.435	0.547
	0.2		0.302	0.404	0.505	0.607
	0.3		0.392	0.484	0.575	0.667
	0.4		0.482	0.564	0.645	0.727

(PDS-2001, PRHFPS-2000-01). This analysis of the proximate determinants of fertility suggests that late marriage, divorce and widowhood, and contraceptive use are the key factors reducing the prevailing levels of fertility in Pakistan from their biological maximum. However, the induced abortion has only a very minor fertility inhibiting effect. Thus, the use and prevalence of contraception has been identified as an important determinant for the reduction in fertility that has to be achieved in the future. Contraceptive method-specific proportion of women must be increased. This study shows the advantage of analyzing fertility determinants at the aggregate level, but still the age-specific version of the proximate determinants model of fertility remains to be explored.

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Appendix A: Calculations of Bonggart's indices

Age Group	m(a)	g(a)	m(a)g(a)
15-19	0.150	173.00	25.9500
20-24	0.511	279.50	142.8245
25-29	0.811	282.90	229.4319
30-34	0.921	210.101	93.5021
35-39	0.930	125.201	16.4360
40-44	0.918	62.10	57.0078
45-49	0.892	24.50	21.8540

PDS-2001

No. of induced abortion (x)	No. of women (f)	f x
0	6388	0
1	105	105
2	33	66
3 and over	53	185.50

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

$$= \frac{4.7}{4.7 + 0.4(1.188)0.0542} = 0.9946 \approx 0.9$$

Source: PRHFPS-2001