CHAPTER FIVE
PROXIMATE DETERMINANTS OF FERTILITY IN RWANDA

5.1. Introduction.

It has been reported that changes in fertility behaviour is linked to direct and indirect determinants. The direct determinants are generally known as proximate variables and the indirect ones are considered as socioeconomic variables. If one or more proximate determinants are altered, the fertility behaviour necessarily changes as well.

According to Bongaarts (1982), Davis and Blake were the first to identify a set of 11 proximate determinants known as “Intermediate Fertility Variables”. Nevertheless, their classification did not get wide acceptance because it was not easily incorporated in fertility analysis. In view of that, Bongaarts (1978) reclassified this list of determinants into seven variables, including marriage pattern, contraceptive use, induced abortion, lactation infecundability, spontaneous abortion, frequency of coitus and sterility.

However, after various studies, Bongaarts realized that some of these factors are more relevant than others in determining the magnitude of fertility change. In fact, only four of them (marriage, contraceptive use and effectiveness, induced abortion and postpartum infecundability) are the most important in explaining fertility variation, accounting for up to 96% of fertility change in some populations (Bongaarts, 1978). This model has been used to explain fertility dynamics in most countries (developed and developing countries).
In his seminal work, Bongaarts posted that with the inhibitory effect of all the intermediate variables present, a society’s level of fertility is given by the observed total fertility rate. Thus the basic Bongaarts’ model is given as follows:

\[ TFR = TF \times C_m \times C_c \times C_a \times C_i \]

where:
- \(TFR\) and \(TF\) are respectively the total fertility rate and the total fecundity rate
- \(C_m\), \(C_c\), \(C_a\) and \(C_i\) are respectively the index of marriage, the index of contraceptive use, the index of abortion and the index of postpartum infecundability. These indexes measure the fertility-inhibiting effect of the four proximate variables included in Bongaarts’ model.

While \(C_m\) measures the extent to which the total fertility rate is lower than it would be if all women were continuously married between ages 15 and 49, and experienced throughout this period the observed age-specific marital fertility rate; \(C_c\) reflects the relative loss of potential fertility within marriage due to contraceptive use; \(C_i\) reflects fertility loss due to the practice of post-partum behaviour (breastfeeding and postpartum sexual abstinence). Each of these indices take values between 0 and 1. The greater the fertility-inhibiting effect of a given variable, the lower the value and 0 indicates total suppression of fertility by the variable in question, and 1 shows no inhibition at all (Stover, 1998, Bongaarts 1978, Odimegwu & Zerai, 1996, Mwanzu, 2005, Akindolani, 2005).

5.2. Estimation of the indices of the proximate determinants and fertility rates using basic Bongaarts model

In this study, only three proximate variables are considered namely: marriage pattern, contraceptive use, and postpartum infecundability (breastfeeding practices). It is
important to note that the induced abortion variable was excluded from the analysis
given that there are no available data on it; due to the fact that the Rwandan law
prohibits such practice.

5.2.1. Estimation of index of marriage
To make a quantitative assessment of the effect of index of marriage ($C_m$) on fertility
in Rwanda, the following indexes are computed: the total fertility rate (TFR), the total
marital fertility rate (TM), the proportion currently married among females “m (a)”
and a schedule of age-specific fertility rates “f(a)”. These indexes are constructed so
that the index of overall fertility equals the product of the index of marriage and the
total marital fertility rate.

$$TFR = C_m \times TM$$

$$C_m = \frac{TFR}{TM} = \frac{\sum f(a)}{\sum f(a)/m(a)}$$

The index $C_m$ gives the proportion by which TFR is smaller than TM as the result of
non marriage; $C_m = 0$ if no body is married and $C_m = 1$ if all women are married during
the entire reproductive period. The index of marriage is intended to express the
reduction in fertility caused by women’s not being sexually active throughout their
entire reproductive period. The index of marriage extracted from the 2000 RDHS is
0.47. From the relationship $TFR = C_m \times TM$, the $TM = TFR / C_m = 5.7 / 0.47 = 12.13$

5.2.2. Estimation of index of contraceptive use
To estimate the effect of contraception on marital fertility, the following equation
expresses marital fertility as the interaction of contraception practice and natural
fertility:

$$TM = C_c \times TNM$$, where:

TM is the total marital fertility rate;
TNM is the total natural marital fertility rate. TNM equals to TM in the absence of contraception and induced abortion;

C_c is the index of non contraception. When no contraception is practiced, C_c equals 1; when all nonsterile women in the reproductive years are protected by 100 percent effective contraception, C_c =0 and TM =0.

It is known that, if all couples who practice contraceptive use are assumed nonsterile, the index C_c can be estimated as:

\[ C_c = 1 - 1.08 \times e \times u \]

where:

u is the average proportion of married women currently using contraception;

e is the average contraceptive effectiveness;

1.08 is a sterility correction factor.

Since estimates of contraceptive effectiveness are difficult to obtain and therefore rarely available, the table 13 shows the standard method-specific values (adapted from data from the Philippines) which are used in the calculation of average effectiveness levels in developing countries (Bongaarts, 1982).

Table 13: Estimated use-effectiveness by contraceptive method for developing countries

<table>
<thead>
<tr>
<th>Method</th>
<th>Estimated use-effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilization</td>
<td>1.0</td>
</tr>
<tr>
<td>IUD</td>
<td>0.95</td>
</tr>
<tr>
<td>Pill</td>
<td>0.90</td>
</tr>
<tr>
<td>Other</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Source: Bongaarts, 1982
The average use-effectiveness, \( e \), is estimated as the weighted average of the method-specific use-effectiveness levels, \( e(m) \), with the weights equal to the proportion of women using a given method, \( u(m) \):

\[
e = \sum_{m} e(m) u(m) / u.
\]

The table 14 presents the values of \( u(m) \) from 2000 RDHS data.

### Table 14: Estimating the index of contraception (2000 RDHS)

<table>
<thead>
<tr>
<th>Method</th>
<th>( u(m) )</th>
<th>( e(m) )</th>
<th>( u(m) \times e(m) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilization</td>
<td>0.005</td>
<td>1.0</td>
<td>0.005</td>
</tr>
<tr>
<td>IUD</td>
<td>0.004</td>
<td>0.95</td>
<td>0.0038</td>
</tr>
<tr>
<td>Pill</td>
<td>0.056</td>
<td>0.90</td>
<td>0.0504</td>
</tr>
<tr>
<td>Other</td>
<td>0.2390</td>
<td>0.70</td>
<td>0.1673</td>
</tr>
<tr>
<td>Total</td>
<td>0.3040</td>
<td>0.70</td>
<td>0.2265</td>
</tr>
</tbody>
</table>

**Source: computed from 2000 RDHS**

\[
e = 0.2265 / 0.3040 = 0.7451
\]

\[
C_c = 1 - 1.08 \times u \times e = 1 - 1.08 \times 0.3040 \times 0.7451 = 0.755 \text{ or } 0.76
\]

Hence the TNM can be obtained thus: \( TNM = TM / C_c = 12.13 / 0.76 = 15.9 \)

#### 5.2.3: Estimation of index of breastfeeding

Lactation has an inhibitory effect on ovulation and thus increases the birth interval and reduces natural fertility. The ratio of the average birth intervals without and with lactation will be called the index of postpartum infecundability (Bongaarts:1978):

\[
C_i = \frac{20}{18.5 + i}, \text{ where } i \text{ is the mean duration of postpartum infecundability. } C_i \text{ equals 1 in the absence of lactation and postpartum sexual abstinence and 0 if the duration of infecundability is infinite. Given that the direct estimate of } i \text{ is not available, it is possible to obtain an approximate value from the duration of breastfeeding, } B, \text{ with the following equation:}
\]

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\( i = 1.753 \exp (0.1396 \times B - 0.001872 \times B^2). \) In 2000 RDHS report, the estimated median of the duration of breastfeeding is 32 months. Using 2000 RDHS raw data the mean duration of breastfeeding has been computed and found to be 15 months. Given that the difference of these two estimations is big, the average of the two measures is more accurate. Thus, the mean duration of breastfeeding is taken to be 24 months, the average of 32 and 15 months.

Therefore \( i = 1.753 \exp (0.1396 \times 24 - 0.001872 \times 24^2) = \)

\[
= 1.753 \exp(3.28 - 1.03) \\
= 1.753 \exp(2.25) \\
= 1.753 \times 9.48 = 16.6
\]

\( C_i = \frac{20}{18.5 + 16.6} = 0.57 \)

\( TNM = C_i \times \text{TF}; \text{TF} = \frac{TNM}{C_i} = \frac{15.9}{0.57} \Rightarrow \text{TF} = 27.9 = 28 \)

From the above computations, Table 15 and the figure 4 provide the estimates of the proximate determinants and fertility rates for Rwanda in 2000.

**Table 15: Estimates of the indices of the proximate determinants and fertility rates 2000 RDHS**

<table>
<thead>
<tr>
<th>Index estimates</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_m, \text{Proportion married} )</td>
<td>0.47</td>
</tr>
<tr>
<td>( C_c, \text{Contraception Index} )</td>
<td>0.76</td>
</tr>
<tr>
<td>( C_i, \text{Index of post-partum infecundability} )</td>
<td>0.57</td>
</tr>
<tr>
<td>Combined indices, ( C_m \times C_c \times C_i )</td>
<td>0.203</td>
</tr>
</tbody>
</table>

**Estimates of fertility measures**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fecundity</td>
<td>28</td>
</tr>
<tr>
<td>Total fertility rate ((0.203 \times 28))</td>
<td>5.7</td>
</tr>
<tr>
<td>Total marital fertility rate ((0.76 \times 0.57 \times 28))</td>
<td>12.13</td>
</tr>
<tr>
<td>Total natural marital fertility rate ((0.57 \times 28))</td>
<td>15.9</td>
</tr>
</tbody>
</table>

**Source: computed from 2000 RDHS**
In the table 15, the TFR of 5.7 has been estimated because the values of $c_m$, $c_c$ and $c_i$ were known. The estimated TF of 28 is a very high rate and this could be as a result of errors in data collection, errors in the measurement of indeterminate variables. From the above, it is shown that the average fertility-reducing impact of marriage, post-partum infecundability and contraception are respectively 53 percent, 43 and 24 percent. In order to standardize this result it is necessary to measure the relative contribution of each proximate variable.

### 5.3. Relative contribution of each proximate determinant

To measure the magnitude of the total inhibiting effect being accounted for by each of the proximate determinants of fertility is by simple decomposition of the difference between observed and potential fertility. To obtain the inhibiting effect of each proximate the basic Bongaarts model is transformed thus:

$$\ln(TF) - \ln(TFR) = \ln(C_i) + \ln(C_c) + \ln(C_m),$$

where $\ln$ denotes the natural log transformation. The proportional contribution of each determinant to the reduction of fertility from the TF to the TFR is given by the following formula:
\[ C_c = \frac{100 \ln(Cc)}{\ln(Cc) + \ln(Ci) + \ln(Cm)} \]

The above equation yields the percentage reduction of \( C_c \). The percentage contributions of other determinants can be computed thus. This percentaging standardizes the result (Odimegwu, 1996). Using the above formula, the percent reductions by the three proximate determinants are presented in table 16. The details of computations are shown in appendix C.

**Table 16: Percent reduction by proximate determinants**

<table>
<thead>
<tr>
<th>Index</th>
<th>Percent reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marriage Index</td>
<td>47.5</td>
</tr>
<tr>
<td>Post-partum infecundability Index</td>
<td>35.3</td>
</tr>
<tr>
<td>Contraception Index</td>
<td>17.2</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: results from computations

The table 16 shows the percent reduction of each proximate determinant to fertility level in Rwanda. The results reveal that marriage plays much more important role in reducing fertility level (accounting for 47.5 percent) than other proximate variables in this country, followed by the contraceptive practices (35.3%) and the post-partum infecundability(17.2%).

After highlighting the contribution of proximate determinants to fertility reduction, the following section aims to find out the extent to which socioeconomic factors in general, and women’s education in particular, influence fertility through proximate variables in Rwanda.