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MARRIAGE AND MARITAL FERTILITY: A FURTHER DECOMPOSITION OF THEIR EFFECTS IN THE STUDY OF LEVELS AND CHANGES IN BIRTH RATE

T.K. Roy
International Institute for Population Studies, Bombay, India
and
N. Unnikrishnan Nair
University of Kerala, Kerala, India

Résumé — En ce qui concerne la comparaison des niveaux de fécondité des différentes populations, des indices sont disponibles pour isoler et mesurer les contributions du mariage et de la fécondité maritale. La présente étude essaie de décomposer davantage les contributions de ces deux composants en leurs effets respectifs à cause du volume et du modèle. Peu d'indices ont été proposés pour la comparaison des facteurs associés avec les niveaux de taux de naissance dans les différentes populations. En guise d'illustration, on a utilisé la méthodologie pour diriger une étude comparée des niveaux et des changements du taux de naissance dans certains états de l'Inde tout en tenant compte des données des années 1961 et 1971.

Abstract — In order to compare the levels of fertility of different populations, indexes are available which isolate and measure the contributions of marriage and fertility. This paper attempts to further decompose the contributions of the two components into their respective effects due to volume and pattern. Few indexes have been proposed to compare the factors associated with the levels of birth rate in different populations. As an illustration, the methodology has been used to conduct a comparative study of the levels and changes in birth rate in some of the states of India, using data for the years 1961 and 1971.

Key Words — **marriage, marital fertility, decomposition, volume and pattern**

Introduction

In societies where the fertility of non-married women is negligible, marriage habits and marital fertility constitute the two basic components which determine the level of fertility of the population. The ultimate level of the fertility index — crude birth rate — in such populations depends on (1) the proportion of married women in the reproductive age group to total population (volume of married women), (2) the distribution of married women relative to total population at different reproductive age intervals (pattern of married women), (3) the level or volume of marital fertility and (4) the pattern of marital fertility by age. Thus both marriage and marital fertility, the two components into which the level or change in fertility is usually attributed, can be subdivided into two distinct components — volume and pattern. Further decomposition of the contribution of marriage and marital fertility into their respective effects due to volume and pattern can enhance our understanding in comparing levels of fertility of different populations or studying the mechanism underlying change in fertility of a population.

Objective

This study proposes an extension of the two indexes — marriage and marital fertility — suggested by Coale (1967) to study the levels and changes in the birth rate of a population. As an

illustration, the methodology has been used, with the help of the relevant data for the years 1961 and 1971, to carry out a comparative study of the levels and changes in the birth rate of some of the states of India and the country as a whole.

Comparison of Factors Associated with Levels of Birth Rate in Different Populations

In order to compare levels of birth rate in different populations, the factors affecting birth rate can be suitably reclassified as (1) volume of married women, (2) volume of marital fertility and (3) interconnection between pattern of married women and pattern of marital fertility. The last component, referred to hereafter as "degree of interrelationship," takes into account two factors – age pattern of married women and age pattern of marital fertility. It signifies the extent to which age patterns of married women and marital fertility (for a given volume of married women and marital fertility) are interrelated in a population so as to produce a given birth rate. This provides valuable information regarding the level of birth rate of a population. It is not necessary and seems difficult to segregate this term into its two constituent parts. In other words, it is difficult to determine independent effects of volume and pattern for the two factors – marriage and marital fertility. For that matter, it is also not easy to ascertain the overall effects of the two factors (combined for volume and pattern).

In his pioneering work regarding comparison of levels of fertility of different populations, Coale suggested two indexes to isolate and measure the contributions of marital fertility and proportion married to overall fertility (Coale, 1967). He used these indexes to study the decline of fertility in various European populations (Coale, 1969). Although the index of marital fertility, I_g, to a large extent succeeds in isolating the contribution of marital fertility, it contains some influence on the degree of interrelationship between patterns of married women and marital fertility. Let us examine the two populations shown in Table 1.

It can be observed that even though marital fertility is exactly similar in the two populations, both in terms of its volume and pattern, the value of I_g is different. This is due to the difference in the degree of interrelationships between patterns of married women and marital fertility in the two populations. I_g is computed in the following manner:

$$I_g \text{ (for population A)} = \Sigma m_i g_i / \Sigma m_i F_i$$

$$I_g \text{ (for population B)} = \Sigma m_i' g_i' / \Sigma m_i' F_i$$

where m_i and m_i' are the proportions of married women to total population in different reproductive age intervals in populations A and B respectively, and g_i and g_i' are the age-specific marital fertility rates (ASMFR) in A and B respectively. F_i represents the ASMFR of the standard population (married Hutterites, 1921-30). Coale (1967) has furnished the values of F_i. The degree of interrelationship between m_i with g_i and F_i could be different from those between m_i' with g_i' and F_i. This happens because the value of m_i which has been used as standard for comparing g_i and F_i varies over the different populations. The fact that I_g is affected by a change in proportion of married women (m_i) can be illustrated mathematically. Suppose that there is a slight change in the value of one of the m_i's by an amount Δm_i and let the corresponding change in I_g be ΔI_g. It can easily be seen that

$$\Delta I_g = \frac{(g_i - F_i I_g)\,\Delta m_i}{\Sigma m_i F_i + F_i \Delta m_i}$$

TABLE 1. DISTRIBUTION OF MARRIED WOMEN TO TOTAL POPULATION AND ASMFR FOR TWO POPULATIONS, A AND B

Age Group	A		B	
	Married women per population	ASMFR	Married women per population	ASMFR
15-19	0.03963	0.2648	0.01015	0.2648
20-24	0.04197	0.2742	0.02974	0.2742
25-29	0.03683	0.2804	0.03306	0.2804
30-34	0.03019	0.1756	0.02830	0.1756
35-39	0.02389	0.1034	0.02345	0.1034
40-44	0.01741	0.0452	0.01860	0.0452
45-49	0.01305	0.0122	0.01468	0.0122
	Married women per population in 15-49 = .20297		Married women per population in 15-49 = .15798	
	TMFR =5.7790		TMFR =5.7790	
	Ig = .50		Ig = .45	

Source: Population Structure in A is similar to that of Andhra Pradesh (1961) shown in Appendix Table 1. Proportion of married women in Population B is assumed to be as that of Kerala (1971) (Appendix Table 1).

Even though ΔI_g is not directly proportional to Δm_i, nevertheless it is not zero.

To study the factors that affect levels of birth rates in different populations, it is therefore proposed to construct the following simple indexes: (1) index of birth rate (I_b), measuring the extent to which birth rates in a given population and a standard population differ from each other, (2) index of volume of married women (I_{vm}), measuring the degree of divergence in the number of married women per unit population between the given and the standard populations, (3) index of volume of marital fertility (I_{vf}), measuring the extent of variation in volume of marital fertility between the given and the standard populations and (4) index of degrees of interrelationship (I_d), measuring the extent of variation in interrelationship between patterns of married women and marital fertility in the given population and the standard population. If M_i denotes the proportion of married to total population in the reproductive age group i in the standard population, $m = \Sigma m_i$, and $M = \Sigma M_i$, and the indexes can be written symbolically as

$$I_b = \Sigma m_i g_i / \Sigma M_i F_i$$

$$I_{vm} = \Sigma M_i \frac{m}{M} F_i / \Sigma M_i F_i = m/M$$

$$I_{vf} = \Sigma M_i F_i \frac{g}{F} / \Sigma M_i F_i = g/F$$

$$I_d = \frac{M}{m}\frac{F}{g} \Sigma m_i g_i / \Sigma M_i F_i$$

where g and F represent the total marital fertility rate for the given and the standard populations. It is easy to see that

$$I_b = I_{vm} I_{vf} I_d$$

It can be shown that I_b can be expressed as

$$I_b = 1 + \tfrac{1}{2} [\Sigma A_i(m_i - M_i) + \Sigma B_i(g_i - F_i)]$$

where

$$A_i = (g_i + F_i) / \Sigma M_i F_i$$

and

$$B_i = (m_i + M_i) / \Sigma M_i F_i$$

Thus I_b has two components, namely, (1) changes due to differences in proportion married and (2) changes due to a difference in marital fertility. Coale, by asssuming $m_i = M_i$, did not consider the first aspect in his index I_g.

From the proposed indexes, it is evident that I_b has been decomposed into the three component parts, I_{vm}, I_{vf} and I_d. This means that it is not feasible to isolate the overall impact of the two components marriage and marital fertility. There seems to be some mathematical justification for this argument. Let $\Delta_1 I_b$ and $\Delta_2 I_b$ be the corresponding changes in I_b occurring due to a change in m_i by an amount Δm_i and a change in g_i by an amount Δg_i respectively. Then

$$\Delta_1 I_b = \Sigma g_i \cdot \Delta m_i / \Sigma M_i F_i$$

$$\Delta_2 I_b = \Sigma m_i \cdot \Delta g_i / \Sigma M_i F_i$$

And, the total change in I_b, measured as ΔI_b is

$$\Delta I_b = \Delta_1 I_b + \Delta_2 I_b + \Sigma \Delta m_i \Delta g_i / \Sigma M_i F_i$$

It is apparent, therefore, that total change in I_b cannot be estimated simply as the sum of total changes due to proportion married and marital fertility. It would be further informative to consider the following additional indexes.

$$I_1 = \Sigma m_i g_i / \Sigma M_i g_i$$

$$I_2 = \Sigma m_i g_i / \Sigma m_i F_i$$

I_1 measures the extent to which the birth rate in a given population can be regulated if its proportion of married women converges to that of the standard population. Similarly, I_2 (which is same as Coale's index I_g) indicates how much reduction in the birth rate in a population is possible if its ASMFR becomes the same as that of the standard population. The comparison is not essentially between different populations, but rather, between each population and the standard one. The utility of these two indexes will be further discussed in the section on comparison of the factors associated with levels of birth rate in some of the states of India.

Decomposition of Effects of Different Factors on the Measurement of Change in the Birth Rate

In this case, since the values of m_i and g_i are available at two points in time for a population, the effects and interactions of each of the four factors — pattern and volume of marriage and marital fertility — in affecting birth rate can be analysed fruitfully. The method of computing the 15 different effects and interactions have been presented in the appendix. The effect of any factor, for example, pattern of married women, indicates the extent to which the birth rate of a population has changed because of a change in the pattern of marriage alone. Interaction between any two factors reflects the differential effect of one factor at the two levels (observed at the two different points of time) of the other factor.

Comparison of the Factors Associated with Levels of Birth Rate in Some of the States of India

Ten states of India and the country as a whole have been selected to illustrate the factors responsible for their different levels of birth rate. The selection of the states was made primarily on the basis of availability of relevant data. The analysis was carried out for two periods — 1961 and 1971. Values of m_i and g_i for each of these states have been presented in Table A1 (see appendix). Relevant data for computing m_i have been obtained from the two censuses. For this, the adjusted age distributions have been utilized. Age-specific fertility rates for different states in 1961 were first taken from the National Sample Survey (India, 1963). These rates were then inflated or deflated by a constant factor so that the adjusted rates would produce birth rates in the respective states to conform with the estimates given by the Registrar General of India for the decade 1951 to 1960; the ASMFR were estimated from these adjusted rates (Rao, 1967). For the year 1971, the patterns of ASMFR were borrowed from the large-scale fertility survey conducted by the office of the Registrar General of India (India, 1976). The levels of these marital fertility rates were again adjusted to yield birth rates of different states in 1971 that agree with the corresponding estimates of the Sample Registration Schemes (SRS) (India, 1975). The fertility rate was estimated in a survey which sought information on whether a woman had given birth in the 12 months immediately preceding the survey. There is a possibility that this reference period may not be correctly represented by the respondents and can be, therefore, either overestimated or underestimated. Thus, even though pattern of fer-

tility can be estimated correctly, usually the level of fertility estimated from a survey needs some adjustment (Brass and Coale, 1968). Since SRS estimates of birth rates appear to be reasonably accurate, they have been utilized to adjust the overall level of fertility or marital fertility from the survey.

To calculate the indexes suggested for comparing the factors associated with the levels of birth rate in different populations, it is necessary to select a standard population. There is no fixed rule for the selection of such a population. Comparison of these indexes between different states will not be affected by a change in the standard population. In the present analysis, the standard population is assumed to constitute the proportion of married women to total population (M_i) in the state of Kerala (1971) and the ASMFR (F_i) of Maharashtra in 1971. The two components of this standard population — M_i and F_i — can be regarded as ideal, at least with respect to volumes of married women and marital fertility, which all the states would like to attain in order to reduce their birth rates. In a recent attempt to estimate future family planning targets for India, Srinivasan *et al.* (1980) suggested that all the states of the country should aim at achieving the Kerala pattern of marriage eventually, but no later than the turn of the century. Such a standard population, apart from serving the desired purpose, can also enhance our knowledge regarding the extent to which the individual states have to make efforts to resemble the ideal population and whether, during 1961 and 1971, they had progressed in the right direction. Tables 2 and 3 provide the values of the different indexes proposed earlier, for these two years respectively.

In comparison to the standard population, crude birth rates are found to be much higher in all the states. In 1961, the highest birth rate was obtained in Assam. Its birth rate did, however, decline considerably during the interval. As of 1971, it required another 31 per cent ($1 - 1/I_b$ per cent) decline in its level of birth rate to reach the level of the standard population. The birth rate in Tamil Nadu was found to be the minimum in 1961, whereas Kerala occupied this position in 1971. All the states, except Rajasthan, registered a decline in their birth rate. The country as a whole needed another 28 per cent decline in the birth rate in order to attain the birth rate of the standard population.

The volume of married women was found to be higher in the states of Madhya Pradesh, Andhra Pradesh, Orissa, Rajasthan, Maharashtra and Tamil Nadu as compared to all India in 1961. Apart from Rajasthan, the values of I_{vm} in these states were higher than either I_{vf} or I_d. In 1971, this group became larger as Karnataka was added. It is evident that the volume of married women did not undergo considerable change during the two periods. Nevertheless, all the states, except Assam, registered a decline in I_{vm}.

The value of I_{vf} was highest in Assam, followed by Kerala, Gujarat, Karnataka, Rajasthan and India as a whole in 1961. In all these places, its contribution is greater than either I_{vm} or I_d. During 1961 and 1971, the volume of marital fertility declined substantially in some of the states, notably Assam, Karnataka, Kerala and Maharashtra. As a result of this decline, the contribution of I_{vm} turned out to be greater than that of I_{vf} in the majority of the states in 1971.

If all the places had similar values of I_{vm} and I_{vf} in 1961, the states of Andhra Pradesh and Karnataka would have recorded maximum birth rates in that year. The degree of interrelationship between patterns of married women and marital fertility was the highest in these two states. For example, Andhra Pradesh would have had a much lower birth rate (less by about seven per cent) if it had the same I_d as did Rajasthan in 1961. Karnataka registered considerable decline in I_d during 1961 and 1971. This means that either the pattern of married women, the pattern of marital fertility or both patterns changed in such a way as to favour a much lower birth rate in the later period. For example, birth rate in Karnataka in 1971 would

TABLE 2. VALUES OF DIFFERENT INDEXES FOR SELECTED STATES IN INDIA, 1961

Index	States										All India
	Andhra-Pradesh	Assam	Gujarat	Karnataka	Kerala	Madhya Pradesh	Mahara-shtra	Orissa	Rajas-than	Tamil Nadu	
I_b	1.544	1.791	1.675	1.653	1.505	1.616	1.562	1.476	1.588	1.345	1.567
I_{vm}	1.285	1.020	1.190	1.194	1.039	1.305	1.240	1.259	1.255	1.227	1.224
I_{vf}	1.128	1.698	1.401	1.300	1.456	1.217	1.207	1.163	1.277	1.095	1.260
I_d	1.066	1.034	1.005	1.065	0.994	1.018	1.044	1.008	0.993	1.002	1.016
I_1	1.439	1.111	1.205	1.366	1.076	1.355	1.320	1.312	1.296	1.356	1.283
I_2	1.155	1.389	1.375	1.307	1.410	1.196	1.204	1.157	1.233	1.055	1.242

TABLE 3. VALUES OF DIFFERENT INDEXES FOR SELECTED STATES IN INDIA, 1971

Index	States										All India
	Andhra Pradesh	Assam	Gujarat	Karnataka	Kerala	Madhya Pradesh	Mahara-shtra	Orissa	Rajas-than	Tamil Nadu	
I_b	1.309	1.448	1.505	1.193	1.170	1.471	1.211	1.302	1.595	1.181	1.389
I_{vm}	1.237	1.026	1.137	1.128	1.000	1.258	1.187	1.254	1.249	1.166	1.180
I_{vf}	1.032	1.365	1.329	1.059	1.195	1.186	1.000	1.049	1.297	1.024	1.185
I_d	1.026	1.034	0.996	0.998	0.980	0.985	1.021	0.990	0.985	0.989	0.993
I_1	1.320	1.097	1.147	1.172	1.000	1.295	1.211	1.295	1.241	1.184	1.201
I_2	1.037	1.344	1.311	1.030	1.170	1.152	1.000	1.023	1.253	1.000	1.161

have been higher by about two points (33.81 instead of 31.70 per 1000 population) if I_d had not changed during 1961 and 1971. In 1961, the value of I_d happened to be lowest in Rajasthan, closely followed by Kerala. These values were even lower than the corresponding value for the standard population. Hence, in these two states, the patterns of married women and marital fertility are such that they are most favourable towards having a lower birth rate. Kerala had the lowest birth rate in 1971. This happened not only because the state had the lowest volume of married women but also because of the presence of a favourable interrelationship between patterns of married women and marital fertility.

On the whole, it appears that all the states except Rajasthan have made substantial progress in controlling their birth rates. However, it is the volume of marital fertility that has played a major role in this endeavour. The role of marriage in terms of volume of married women and the degree of interrelationship (I_d) has not been properly emphasised. As of 1971, a majority of the states could expect to perform better to lower their rates if they adequately reduce the volume of married women, and there lies ample scope for reducing the value of I_d which will bring an additional reduction in the birth rate. I_d for example, can be decreased by having family planning users distributed over the age groups in such a manner that a relatively greater decline in marital fertility can be obtained in age groups where proportion of married women is also larger. Only Karnataka and, to a lesser extent, Andhra Pradesh could achieve this to any noticeable degree.

The values of I_1 (Table 3) reveal that considerable reduction in birth rate can be achieved in all the states if they change their proportion of married women by adopting the Kerala pattern. For example, even if marital fertility remains unchanged in Andhra Pradesh, Madhya Pradesh and Crissa, these states can reduce their birth rates by more than 20 per cent by accomplishing such a change in proportion of married women. Similarly, values of I_2 from the same table suggest that states like Assam, Gujarat and Rajasthan can expect to achieve substantial reduction in their birth rates if they attain Maharashtra's level of ASMFR.

Comparison of the Effects of Different Components in Assessing Change in Birth Rates in the States

Table 4 presents the effects and interactions of the different components of marriage and marital fertility with a view towards explaining the changes in birth rates in the different areas between 1961 and 1971. According to Table 4, the pattern of married women changed in a direction which was conducive to a lower birth rate. This is true, of course, in varying degrees for all the areas examined. Its impact is the highest in Tamil Nadu, where the birth rate declined by about three points. In all the four southern states, namely Tamil Nadu, Karnataka, Andhra Pradesh and Kerala, the effect of this factor was relatively large. Its effect was also quite substantial in Maharashtra. In all the other areas, changes in the pattern of married women did not appear to have made much impact.

Volume of married women also acted favourably towards a decline in the birth rate in most of the states. Again, its effect tended to be greater in the case of the southern states. Gujarat, Maharashtra, and Madhya Pradesh also achieved considerable decline in birth rate because of a change in the volume of married women. Only in Assam did this factor change unfavourably.

Karnataka and Madhya Pradesh experienced considerable reductions in birth rate as a result of favourable changes in their age pattern of marital fertility. Tamil Nadu could have had further reduction in the birth rate had there not been an unfavourable change in its pattern of

TABLE 4. EFFECTS AND INTERACTIONS OF THE DIFFERENT FACTORS IN ASSESSING BIRTH RATE CHANGES BETWEEN 1961 AND 1971.

	States										All India
	Andhra Pradesh	Assam	Gujarat	Karnataka	Kerala	Madhya Pradesh	Mahara-shtra	Orissa	Rajas-than	Tamil Nadu	
M_d	-.00148	-.00008	-.00043	-.00243	-.00137	-.00072	-.00126	-.00012	-.00033	-.00273	-.00082
M_v	-.00153	.00028	-.00199	-.00243	-.00151	-.00155	-.00178	-.00016	-.00019	-.00177	-.00150
M_dM_v	.00006	0	.00002	.00013	.00005	.00002	.00005	0	0	.00014	.00003
F_d	-.00029	-.00020	.00019	-.00132	.00071	-.00068	.00010	-.00053	-.00013	.00112	-.00024
M_dF_d	.00024	.00027	-.00015	.00099	.00007	.00004	.00024	-.00003	.00021	.00117	.00014
M_vF_d	.00001	0	-.00001	.00007	-.00003	.00002	0	0	0	-.00005	.00001
$M_vM_dF_d$	-.00001	0	.00001	-.00005	0	0	-.00001	0	0	-.00006	-.00001
F_v	-.00350	-.00936	-.00228	-.00814	-.00717	-.00108	-.00713	-.00385	.00063	-.00233	-.00249
M_dF_v	.00013	.00001	.00002	.00045	.00025	.00002	.00022	.00001	0	.00018	.00005
M_vF_v	.00013	-.00005	.00010	.00045	.00027	.00004	.00031	.00002	0	.00012	.00009
$M_dM_vF_v$	-.00001	0	0	-.00002	-.00001	0	-.00001	0	0	-.00001	0
F_dF_v	.00002	.00004	-.00001	.00024	-.00013	.00002	-.00002	.00005	0	-.00007	.00001
$M_dF_dF_v$	-.00002	-.00005	.00001	-.00018	-.00001	0	-.00004	0	0	-.00008	-.00001
$M_vF_dF_v$	0	0	0	-.00001	0	0	0	0	0	0	0
$M_dM_vF_dF_v$	0	0	0	.00001	0	0	0	0	0	0	0
Total Change	-.00625	-.00914	-.00452	-.01224	-.00888	-.00387	-.00933	-.00461	.00019	-.00437	-.00474

marital fertility. It is obvious that the volume of marital fertility is the most important factor in the change in birth rate in all the states.

The interaction terms are generally found to be very small. Interaction between patterns of married women and marital fertility ($M_d F_d$) was noticeably high for Tamil Nadu and Karnataka. The positive value of this interaction indicates that the effect that a change in the pattern of married women has on reducing the birth rate declined at the 1971 pattern of marital fertility from what it could have been at the 1961 pattern of F_d. In Karnataka, though both M_d and F_d changed favourably, their interaction is unfavourable. It can be easily seen that

$$M_d + F_d + M_d F_d = \frac{m_1 g_1}{m_2 g_2} \Sigma m_{2i} g_{2i} - \Sigma m_{1i} g_{1i}$$

This equation can be considered to give a fairly good estimate of the overall effect of patterns of married women and marital fertility (because interactions between either M_d or F_d with the other two components were negligible). The value of this overall effect (Table 4) was found to be the highest in Karnataka, followed by Andhra Pradesh, Madhya Pradesh and Maharashtra, to mention a few. A similar finding was also obtained by considering the percentage decline in the values of I_d from Tables 2 and 3.

It is rational to believe that the volume of marital fertility can be reduced by increasing the percentage of couples protected by the family planning programme. The importance of age distribution of the protected couples can be studied by examining the overall effect of patterns of married women and marital fertility. It is apparent (from Table 4) that Karnataka, where the greatest decline in birth rate took place during the decade, did not achieve this merely through greater increase in the percentage of couples protected. In this state, age distribution of the acceptors was also favourable, which helped in achieving a relatively greater reduction in the birth rate per unit increase in the percentage of couples protected. Along with this, the volume of married women also changed suitably to accelerate the pace of decline in the birth rate in Karnataka.

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Appendix

Effects and Interaction of the Four Components

Let m_{1i} and g_{1i} be the proportion of married women to the total population and marital fertility rate respectively at age interval i for a population at time t_1, and m_{2i} and g_{2i} be the corresponding values at time t_2. Let $m_1 = \Sigma m_{1i}$, $m_2 = \Sigma m_{2i}$, $g_1 = 5 \Sigma g_{1i}$, and $g_2 = 5 \Sigma g_{2i}$. Total change in birth rate as observed in the population is

$$\Sigma m_{2i} g_{2i} - \Sigma m_{1i} g_{1i} \tag{1A}$$

Equation 1A can be expressed as the sum of the following effects and interactions:

Effect of pattern of married women

$$(M_d) = \frac{m_1}{m_2} \Sigma m_{2i} g_{1i} - \Sigma m_{1i} g_{1i}$$

Effect of volume of married women

$$(M_v) = [(m_2/m_1) - 1] \Sigma m_{1i} g_{1i}$$

Effect of interaction between volume and pattern of married women

$$(M_d M_v) = (1 - \frac{m_1}{m_2}) \Sigma m_{2i} g_{1i} - (\frac{m_2}{m_1} - 1) \Sigma m_{1i} g_{1i}$$

Effect of pattern of marital fertility

$$(F_d) = \frac{g_1}{g_2} \Sigma m_{1i} g_{2i} - \Sigma m_{1i} g_{1i}$$

Effect of interaction between patterns of married women and marital fertility

$$(M_d F_d) = \frac{m_1}{m_2}\frac{g_1}{g_2}\Sigma m_{2i} g_{2i} - \frac{m_1}{m_2}\Sigma m_{2i} g_{1i} - \frac{g_1}{g_2}\Sigma m_{1i} g_{2i} + \Sigma m_{1i} g_{1i}$$

Effect of interaction between volume of married women and pattern of marital fertility

$$(M_v F_d) = (\frac{m_2}{m_1} - 1)[\frac{g_1}{g_2}\Sigma m_{1i} g_{2i} - \Sigma m_{1i} g_{1i}]$$

Effect of interaction among pattern of married women, volume of married women and pattern of marital fertility

$$(M_d M_v F_d) = (1 - \frac{m_1}{m_2})[\frac{g_1}{g_2}\Sigma m_{2i} g_{2i} - \Sigma m_{2i} g_{1i}] - (\frac{m_2}{m_1} - 1)[\frac{g_1}{g_2}\Sigma m_{1i} g_{2i} - \Sigma m_{1i} g_{1i}]$$

Effect of volume of marital fertility

$$(F_v) = (\frac{g_2}{g_1} - 1)\Sigma m_{1i} g_{1i}$$

Effect of interaction between pattern of married women and volume of marital fertility

$$(M_d F_v) = (\frac{g_2}{g_1} - 1)[\frac{m_1}{m_2}\Sigma m_{2i} g_{1i} - \Sigma m_{1i} g_{1i}]$$

Effect of interaction between volumes of married women and marital fertility

$$(M_v F_v) = (\frac{m_2}{m_1} - 1)(\frac{g_2}{g_1} - 1)\Sigma m_{1i} g_{1i}$$

Effect of interaction among pattern of married women, volume of married women and volume of fertility

$$(M_d M_v F_v) = (\frac{g_2}{g_1} - 1)(1 - \frac{m_1}{m_2})\Sigma m_{2i} g_{1i} - (1 - \frac{m_2}{m_1})(1 - \frac{g_2}{g_1})\Sigma m_{1i} g_{1i}$$

Effect of interaction between volume and pattern of marital fertility

$$(F_d F_v) = (1 - \frac{g_1}{g_2})\Sigma m_{1i} g_{2i} - (\frac{g_2}{g_1} - 1)\Sigma m_{1i} g_{1i}$$

Effect of interaction among pattern of married women, pattern and volume of marital fertility

$$(M_d F_d F_v) = (1 - \frac{g_1}{g_2})[\frac{m_1}{m_2}\Sigma m_{2i} g_{2i} - \Sigma m_{1i} g_{2i}] - (\frac{g_2}{g_1} - 1)[\frac{m_1}{m_2}\Sigma m_{2i} g_{1i} - \Sigma m_{1i} g_{1i}]$$

Effect of interaction among volume of married women, pattern and volume of marital fertility

$$(M_v F_d F_v) = (\frac{m_2}{m_1} - 1)(1 - \frac{g_1}{g_2})\Sigma m_{1i} g_{2i} + (\frac{m_2}{m_1} - 1)(1 - \frac{g_2}{g_1})\Sigma m_{1i} g_{1i}$$

Effect of interaction among volume of married women, pattern of married women, volume and pattern of marital fertility

$$(M_d M_v F_d F_v) = (1 - \frac{g_1}{g_2})[(1 - \frac{m_1}{m_2}) \Sigma m_{2i} g_{2i} + (1 - \frac{m_2}{m_1}) \Sigma m_{1i} g_{2i}]$$

$$+ (1 - \frac{g_2}{g_1})[(1 - \frac{m_1}{m_2}) \Sigma m_{2i} g_{1i} + (1 - \frac{m_2}{m_1}) \Sigma m_{1i} g_{1i}]$$

It can be easily seen that sum of these 15 effects and interactions is equal to the total change in the birth rate (mentioned in equation 1A).

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APPENDIX TABLE 1. VALUES OF m_i AND g_i FOR SELECTED STATES IN INDIA, 1961 AND 1971

Age Group	Andhra Pradesh				Assam			
	1961		1971		1961		1971	
	m_i	g_i	m_i	g_i	m_i	g_i	m_i	g_i
15-19	.03963	.2648	.03208	.2145	.02583	.3834	.02050	.2696
20-24	.04197	.2742	.03916	.2837	.03175	.4649	.03359	.3429
25-29	.03683	.2804	.03515	.2210	.03052	.3828	.03331	.3084
30-34	.03019	.1756	.03038	.1671	.02682	.2516	.02756	.2395
35-39	.02389	.1034	.02560	.1177	.02064	.1435	.02144	.1582
40-44	.01741	.0452	.01883	.0427	.01490	.0860	.01511	.0749
45-49	.01305	.0122	.01421	.0105	.01071	.0279	.01060	.0047
15-49	.20297	5.7790	.19541	5.2860	.16117	8.7005	.16211	6.9910

Age Group	Gujarat				Karnataka			
	1961		1971		1961		1971	
	m_i	g_i	m_i	g_i	m_i	g_i	m_i	g_i
15-19	.02733	.2007	.01907	.2067	.03440	.3228	.02471	.1877
20-24	.03793	.3275	.03629	.3293	.04083	.3148	.03662	.2637
25-29	.03505	.3302	.03452	.3215	.03570	.2904	.03378	.2329
30-34	.03050	.2759	.02976	.2334	.02886	.1899	.02839	.1671
35-39	.02460	.1951	.02481	.1600	.02217	.1396	.02367	.1256
40-44	.01858	.0765	.01967	.0905	.01553	.0477	.01775	.0857
45-49	.01404	.0292	.01550	.0203	.01108	.0270	.01323	.0227
15-49	.18803	7.1755	.17962	6.8085	.18857	6.6610	.17815	5.4270

Age Group	Kerala				Madhya Pradesh			
	1961		1971		1961		1971	
	m_i	g_i	m_i	g_i	m_i	g_i	m_i	g_i
15-19	.01510	.3070	.01015	.2117	.03847	.1934	.03689	.2107
20-24	.03342	.3294	.02974	.3233	.04101	.3007	.03895	.2435
25-29	.03353	.3468	.03306	.2734	.03845	.2804	.03432	.2659
30-34	.02867	.2436	.02830	.2038	.03166	.2012	.02991	.2213
35-39	.02316	.1989	.02345	.1330	.02476	.1871	.02544	.1538
40-44	.01718	.0637	.01860	.0661	.01834	.0562	.01915	.0957
45-49	.01313	.0022	.01468	.0129	.01352	.0279	.01412	.0247
15-49	.16419	7.4580	.15798	6.1210	.20621	6.2345	.19878	6.0780

Age Group	Maharashtra				Orissa			
	1961		1971		1961		1971	
	m_i	g_i	m_i	g_i	m_i	g_i	m_i	g_i
15-19	.03381	.2079	.02417	.1505	.03251	.2224	.02879	.2011
20-24	.04003	.3264	.03642	.2689	.03822	.2971	.03946	.2324
25-29	.03787	.2648	.03656	.2449	.03595	.2777	.03646	.2612
30-34	.03099	.2273	.03163	.1806	.03202	.1805	.03143	.1673
35-39	.02376	.1340	.02565	.1162	.02579	.1369	.02654	.1135
40-44	.01718	.0500	.01911	.0468	.01939	.0345	.02016	.0714
45-49	.01225	.0265	.01393	.0168	.01502	.0326	.01524	.0278
15-49	.19589	6.1845	.18747	5.1235	.19890	5.9585	.19808	5.3735

APPENDIX TABLE 1. CONTINUED

Age Group	Rajasthan				Tamil Nadu			
	1961		1971		1961		1971	
	m_i	g_i	m_i	g_i	m_i	g_i	m_i	g_i
15-19	.04003	.2078	.03514	.1694	.02209	.3365	.01290	.2008
20-24	.03893	.2971	.03896	.2867	.04051	.2871	.03580	.2934
25-29	.03485	.2770	.03546	.3231	.03905	.2267	.03815	.2335
30-34	.02993	.1870	.02999	.2415	.03289	.1447	.03358	.1645
35-39	.02373	.2152	.02443	.1690	.02613	.0965	.02754	.1027
40-44	.01743	.0747	.01867	.1028	.01902	.0295	.02071	.0398
45-49	.01332	.0502	.01466	.0361	.01409	.0009	.01553	.0142
15-49	.19822	6.5450	.19731	6.6430	.19378	5.6095	.18421	5.2445

Age Group	All India			
	1961		1971	
	m_i	g_i	m_i	g_i
15-19	.03312	.2230	.02636	.1931
20-24	.03870	.3102	.03663	.2832
25-29	.03587	.2803	.03467	.2708
30-34	.03046	.2226	.03012	.2167
35-39	.02407	.1587	.02501	.1457
40-44	.01785	.0690	.01911	.0780
45-49	.01333	.0273	.01452	.0263
15-49	.19340	6.4555	.18642	6.0690