The Effect of Socio-economic Factors in the falling off Fertility Rates throughout the World Countries

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Abstract:

This paper aimed to study the effect of economic and social factors in the falling off fertility rates throughout the World. The fertility rates all over the world are declining, and many socio-economic factors are seemed to be associated with this decline. The study examined these factors which include: the percentage of contraceptive prevalence, the infant mortality rate, the real per capita income, the female participation in the labour force, the adult literacy rate for males, the adult literacy rate for females, the percentage of the labour force in agriculture, the percentage of population living in urban areas, and the percentage of population with access to health services. On the other hand, and among many fertility measures we used total fertility rate because it is more likely to be affected by these socio-economic variables than other fertility measures. Based on our data, which were taken from the periodicals of the United Nations, the results showed that, and with the exception of the female participation in the labour force, all variables under study showed an extreme significant association with the total fertility rate. Fertility behaviour was shown to be considerably affected by all the variables except the percentage of population living in urban areas and the percentage of population having access to health services. These variables explained almost all the variations in fertility behaviour. The percentage of contraceptive prevalence was the most important variable among these variables. The

study also represented the original variables in fewer factors using the Factor Analysis technique, with which only two factors were extracted: the first one is strongly related to almost all socio-economic variables and the second is related to the female participation in the labour force. This confirmed the strong association between the socio-economic variables and fertility behaviours.

Key Words: Fertility Rates, Mortality Rates, Socio-economic Factors.

الملخص:

يتمركز موضوع هذا البحث في أثر العوامل الاجتماعية والاقتصادية في انخفاض معدلات الخصوبة في عدد من دول العالم. فمعدلات الخصوبة في عموم دول العالم في انخفاض وهذا الاتخفاض فيما يبدو له علاقة وارتباط بالكثير من العوامل الاجتماعية والاقتصادية. ولهذا فحصت هذه الدراسة العديد من هذه العوامل التي شملت: نسبة انتشار المانعات ومعدل وفيات الأطفال حديثي الولادة ومتوسط دخل الفرد الحقيقي ونسبة مشاركة المرأة في العمل ومعدل التعليم بالنسبة للرجال ومعدل التعليم بالنسبة للنساء ونسبة السكان الذين يعملون بالزراعة ونسبة السكان الذين يقطنون المناطق الحضرية ونسبة السكان الذين يتمتعون بخدمات صحية؛ وهي متغيرات لها بيانات متاحة ويُعتَقد أن لها تأثيراً ما بمعدلات الخصوبة. وفي المقابل ومن بين المعدلات المختلفة للخصوبة تم استخدام معدل الخصوبة العام لأنه، على الأرجح، الأكثر تأثرا بهذه العوامل الاجتماعية والاقتصادية. وبناءً على المعلومات التي الحصول عليها من دوريات الأمم المتحدة فإن نتائج الدراسة أوضحت أن كل المتغيرات، باستثناء متغير مشاركة المرأة في العمل، لها ارتباط كبير مع معدل الخصوبة العام. كما أظهرت نتائج الدراسة أن الخصوبة تتأثر بشكل كبير بكل المتغيرات التي شملتها الدراسة باستثناء متغيري نسبة السكان الذين يقطنون المناطق الحضرية ونسبة السكان الذين يتمتعون بخدمات صحية. وكان متغير نسبة انتشار المانعات أكثر المتغيرات أهمية وفاعلية من بين هذه المتغيرات. واستخدمت الدراسة كذلك التحليل العاملي حيث تم استخلاص عاملين لتمثيل متغيرات الدراسة. وقد تمثل العامل الأول بشكل ملحوظ في معظم المتغيرات الاجتماعية والاقتصادية في الدراسة في حين تمثل العامل الثاني مشاركة المرأة في العمل. وبهذا يتضح جلياً ارتباط الخصوبة بالعوامل الاجتماعية والاقتصادية محل البحث.

1- Introduction and Objectives

The dilemma of population growth is one of the crucial problems

that faced and still facing the World. It has troubled the humanity more than once and has been given so much attention and consideration. The basic reason behind these worries is that World population is growing at an incompatible rates in compared with the expand in the available resources of the World. The reduction in mortality rates all over the World was one of the factors that led to this growth. However, it is now hoping that through the fertility decline, which has just been experienced by the World countries, the population growth might be controlled. Accordingly, there are many socio-economic variables that suggested to be the cause for the fertility decline that experienced by the World countries. These variables represent: rising living standards, modernization, urbanization, education, modern medical technology, family planning programs, etc. The percentage of contraceptive prevalence (PCP), the infant mortality rate (IMR), the real per capita income (RPCI), the female percentage in the labour force (FPLF), the adult literacy rate for males (ALRM), the adult literacy rate for females (ALRF), the percentage of the labour force in agriculture (PLFA), the percentage of population living in urban areas (PPU), and the percentage of population with access to health services (PPHS); are the variables which are used to explain the falling of fertility rates throughout the World countries. Among so many measures that could be used to represent fertility conduct, we chose total fertility rate (TFR). Total fertility rate is defined as the average number of live births a woman would have by age 50 if she were subject, throughout her life, to the age-specific fertility rates observed in a given year(UN(2006)).

Our objective, then, is to assess the effectiveness of these variables in fertility levels, and to see the relative strength of each variable in terms

of its influence on fertility decline.

2- Data of the Study

It is obvious from the previous discussion that a proper understanding of the effect of socio-economic variables in fertility decline requires a variety of detailed data on these variables. But the main problems concerning data are their availability and reliability. The data we managed to collect are the recent ones and collected from UNDP (2010), UNFPA(2010), UNICEF(2010) and The World Bank(2010). They are cross-sectional data (data collected on variables at one point in time) for 129 countries representing almost all the world countries, with the exception of some other very small countries and islands. The number of population of these excluded countries and islands is very small and for most of it, if not all, our variables under investigation are not available.

3- Methods and Techniques of Analysis

Keeping our objective in mind, which is the effectiveness of socio-economic variables in the global fertility decline, we are going to use the correlation and regression analyses along with the use of the 'Principle Components analysis' and 'factor analysis'.

4- General Fertility Rates for World Countries

Before studying what socio-economic variables affecting fertility decline, we need to make a comparison between continents and groups of countries regarding the behaviour of total fertility.

According to table (1) and for the world as a whole, total fertility

rate was estimated as 5.1 for 1960 compared with only 4.4 in 2010. But this decrease in total fertility rate was by no means comparable for the major continent-groups and even incompatible inside each continent-group. In 1960, it was noticed that Africa, Asia (with the exception of Japan) and Latin America, which together include well over two-thirds of the World's population, total fertility rates were 6.3, 5.5 and 5.7, respectively; compared with 6.3, 4.4 and 3.8 in 2010. Although there has been a fairly general decrease in total fertility, in some areas the levels are still high, especially in Africa where the tendency for people to reproduce is still strong. This tendency responds quite well to economic and socio-cultural forces. Children serve as a source of pride, of joy, of economic security and of manual labour and therefore offer intrinsic utility to the parents. But like all things, scarcity adds to their value: children in excess of the number wanted in advance will be those easily eliminated by economic changes. For the Oceania, Europe and Northern America, total fertility rate were not only very low but declining steeply as well.

Table (1): Total Fertility Rate 'TFR' (per 1000 population) for 1960 and 2010

Continent	Region	TFR 1960	TFR 2010	Reduction
Africa		**6.3**	**6.3**	**0**
	Eastern Africa	6.8	6.5	0.3
	Middle Africa	5.4	6.4	-1.0
	Northern Africa	7.0	5.2	1.8
	Southern Africa	4.5	5.9	-1.4
	Western Africa	6.6	7.0	-0.4
Asia		**5.5**	**4.4**	**1.1**
	Eastern Asia	2.8	2.5	0.3
	Southeastern Asia	5.2	3.8	1.4
	Southern Asia	6.3	5.2	1.1
	Western Asia	6.8	5.4	1.4
	Japan	2.0	1.7	0.3
Latin America		**5.7**	**3.8**	**1.9**
	Caribbean	4.5	3.1	1.4
	Central America	6.7	4.4	2.3
	South America	5.6	3.7	1.9
Ocienia		**4.3**	**3.0**	**1.3**
	Australia	3.0	1.8	1.2
	New Zealand	3.6	2.0	1.6
	Papua New Guinea	6.2	5.2	1.0
Europe		**2.2**	**1.8**	**0.4**
	Eastern Europe	1.2	1.9	-0.7
	Northern Europe	2.9	1.8	1.1
	Southern Europe	2.1	1.8	0.3
	Western Europe	2.7	1.7	1.0
Northern America		**3.0**	**1.7**	**1.3**
	Canada	3.1	1.6	1.5
	USA	2.9	1.8	1.1
USSR		2.4	1.8	0.6
Whole World		**5.1**	**4.4**	**0.7**

* Source: ref.. 28 through 36.

5- Socio-economic Variables Affecting Fertility Decline

It is very obvious from what we have just stated that the high fertility rates characterized the economically underdeveloped regions of Asia and Africa, and, as suggested by Bogue(1989) and Moazzam(2011), these high levels are likely to be related to the low per capita income, high rates of illiteracy, a large proportion of males engaged in agriculture, and a

large number of persons per physician. Similarly, low levels of fertility, which prevailed in Europe, Northern America and other parts, were accompanied by high income levels, low illiteracy rates, an economy that is primarily non-agricultural, social reforms, and a more adequate supply of physicians. This hypothesizes a relationship between fertility decline, which has been experienced by those affluent countries, and the development which created these socio-economic situations. The main socio-economic variables which are thought to be associated with fertility drops are described separately below.

The historic decline of fertility is generally attributed to a complex of variables related to the process of modernization, economic development and industrialisation. It is sometimes hypothesized, however, that these social and economic variables do not act directly on fertility, but rather have an effect on some intermediate or intervening variables, which in turn influence fertility.

The following are the main socio-economic variables that should be considered in terms of their possible association with fertility decline:-

5.1 Education of women:-

Educational attainment, in general, has been suggested by Caldwell(2001) and Habakkuk(1972) as a contributory factor to fertility decline in both developing and developed countries. Some of the reasons given by UNICEF(2010) why this might be the case is that education affects norms and values of mothers in such a way that they begin to question the traditional practices of their parents in the community.

Moreover, they tend to be more open to advanced technology and have a great opportunity to come into contact with agents, like family planning counsellors, and are more exposed to mass media. Furthermore, extended education is likely to delay marriage and suggest a vocational career as an alternative to constant child rearing. In addition to that, higher educational levels may also be associated with increased economic security, which in turn acts as an incentive for smaller families. All these help to account for the particularly strong correlation to be observed between the level of education of women and fertility behaviour. The adult literacy rate for females (ALRF) is the available variable that will be approached to stand for this effect.

5.2. Education of men:-

Although many studies seem to place greater significance on education of women than on education of men, it seems likely that in many circumstances the education of men is likely to be significant, directly or indirectly. The difficulty that arises in both cases is the extent to which education is a proxy for some other factor - status, income, occupational class or the like. The obvious indicator to be used here is the adult literacy rate for males (ALRM).

5.3 Economic progress and occupational status:-

It is suggested by Simon(1974) and UN(2009) that rising living standards, modernization, and urbanization, are usually accompanied by fertility decline. The reason behind this, as mentioned by UNICEF(2010), is that, with the economic progress the advantages of large families will be vanquished. That is to say, help in fields and homes, security in illness or

old age, etc, are no longer depending on the number of children and instead there will be an increase in cost of having children; since there will be an additional to expenditures necessary to house, feed, clothe and educate a child in accordance with the norms of a better-off society. Although occupational status may be a proxy for economic progress, the two are not the same. Occupation may be an indicator of many factors including economic progress, such as income, wealth, prestige of the occupation and the degree of education associated with the occupation. Anyhow, economic progress and better occupational status are in previous studies expected to be negatively related to fertility. The real per capita income (RPCI) is appropriate measure for economic progress and hence it is the variable that we will use for this effect.

5.4 Infant mortality and other mortality changes:-

It was noted by Preston(1997) , Caldwell(2011), and Buchanan and Rotkirch (2013) that high fertility has frequently been a response for high mortality. The decline in infant and child mortality may themselves cause a fertility decline, since the motives for having a large number of surviving children would be satisfied by lower levels of fertility as mortality rates decline. The death of a child induces a desire to replace him. This will increase the probability of having an additional birth. Also, many parents compensate for the anticipated loss of one or more of their children by giving birth to more children than they actually want. In addition, quoting from UNICEF(2010): "an infant death ends the suppression of ovulation which is caused by breast-feeding. In the absence of any other method of birth planning, a new pregnancy becomes more likely". We are going to rely on infant mortality rate (IMR) to represent this effect.

5.5 Urbanization:-

An urban environment in the long run has been conducive to reduction of human fertility. Urban environment has been regarded by Andorka(1978) and UN(2009) as an essential condition for the development of the attitudes motivating family limitation, and have believed the decline of family size elsewhere to be a consequent of the diffusion from cities of certain aspects of urban living and the urban mentality. The percentage of population in urban areas (PPU) is obviously the appropriate variable to use.

5.6 Labour force participation in agriculture:-

Labour force participation in agriculture is considered by UN(2009) and Buchanon and Rotkirch (2013) as positively related to fertility. This is mainly because, in agricultural settings, children contribute and assist most as manual labours, and woman's economic role is more compatible with child-rearing. It is the percentage of the labour force in agriculture (PLFA) that will be used to reflect this influence.

5.7 Female labour force participation:-

It is Repetto(1979) and UN(2007) who believed that female employment outside the home is an important factor tending to lower fertility and hence they have advocated increasing opportunities for such employment in high fertility areas as a means of reducing birth rates. The option and opportunity to participate is frequently viewed as an element indicative of indirect costs of child-rearing. Usually such indirect costs are presumed to be very different than would be the case in rural areas, where the time constraints of such activities are more flexible and they interfere

less with child-rearing activities. The variable that will be used to capture this effect is the female percentage in the labour force (FPLF).

5.8 Contraception and birth control:-

It is generally accepted by Teachman (1979), Behrman et al(1969), Cutright and Jaffe(1977), Westoff and Ryder(1977), UNICEF(2010) and others that contraception was the principal intermediate and explanatory variable responsible for the shift from high to low fertility. Generally speaking, it is believed that communities or countries with strong family planning programme, including contraception and other control methods, have normally been able to translate progress in reducing deaths into progress in reducing births more quickly than those which do not. Among the types of indirect evidence on the role of contraception in the decline of fertility, the principal one has probably been the widespread general impression that the practice of birth control has increased greatly and that many people could have had more children if they so desired. The percentage of contraceptive prevalence is the available and appropriate variable that we will use in this respect.

5.9 Other variables:-

Of course there are some other variables affecting fertility decline, but because of the unavailability of the suitable data for them we are not going to consider them in this study. These variables include: changes in the rate of migration, change in the extended family system, change in child-rearing costs, old-age security, degree of preference for male (or female) children, and occupational and social mobility.

6- Fertility and Simple Correlations

For the Pearson's correlation coefficient between fertility and each of the socio-economic variables, Table (2) in the next page indicates that all the correlation coefficients are greater than or equal 0.7 - with the exception of the one of the contraceptive prevalence (PCP) which reflected a very high negative correlation with fertility (-0.93), assuring the significance of the contraception and birth control methods in reducing fertility. The infant mortality rate (IMR) proved to be highly correlated with fertility (0.86), next to the percentage of contraceptive prevalence (PCP). The direction of its relationship turned out to be positive, as expected, confirming the belief that fertility has been acting as a response to the high (or low) level of mortality. One might think that fertility is correlated with the socio-economic variables which had already been correlated with mortality. This indirect correlation is in fact true since those variables were highly correlated with mortality and mortality itself is now highly correlated with fertility. So the correlations between fertility and each of the percentage of population with access to health services (PPHS), the real per capita income (RPCI), the percentage of population living in urban areas (PPU), the adult literacy rate for males (ALRM), and the adult literacy rate for females (ALRF), which turned out to be -0.74, -0.71, -0.68, -0.81 and -0.85, respectively, could be thought of as being embodied in the correlation attached to mortality variable. With the correlation of 0.79, the percentage of the labour force in agriculture (PLFA) showed high positive association with fertility.

Table (2): The Correlations between Total Fertility Rate 'TFR' and the Socio-economic Variables

Variable	TFR		Log Variable	TFR
PCP	-0.93		Log PCP	-0.83
IMR	0.86		Log IMR	0.90
ALRF	-0.85		Log ALRF	-0.75
ALRM	-0.81		Log ALRM	-0.74
PLFA	0.79		Log PLFA	0.73
PPHS	-0.74		Log PPHS	-0.68
RPCI	-0.71		Log RPCI	-0.81
PPU	-0.68		Log PPU	-0.64
FPLF	-0.24		Log FPLF	-0.27

Table (2) also shows the correlation between the total fertility rate and log transformations of these socio-economic variables. This log transformation is made in order to absorb the large variations in the values of some variables, especially the real per capita income. The table shows that the Pearson's correlation coefficients for total fertility rate with the log of the real per capita income (RPCI) is relatively higher than before, that is, -0.81 instead of - 0.71. Similarly, the correlation for total fertility rate with the log of the infant mortality rate (IMR) is also higher now, 0.90 instead of 0.86.

7- Fertility and Multiple Regression

Considering all our socio-economic variables, the multiple linear regression of total fertility rate on these variables together is given as

$$\log TFR = 0.237 + 0.00107\ ALRM - 0.00048\ ALRF + 0.000654\ PPU -$$
$$(0.11) \quad (0.12) \quad (0.14) \quad (0.11)$$
$$0.00203\ FPLF + 0.00107\ PLFA - 0.00441\ PCP +$$
$$(0.02) \quad (0.09) \quad (0.00)$$
$$0.000576\ PPHS + 0.273\ \log IMR - 0.0084\ \log RPCI$$

(0.10) (0.00) (0.16)

R2(adjusted) = 0.915 , F-ratio = 112.64

n = 104 , df = 94 , s = 0.07814

Where inside the brackets are the p-values of the corresponding coefficients. The model fit all the variables in order the assess its significance and contributions. This result indicates that only the percentage of contraceptive prevalence (PCP), the log of the infant mortality rate (IMR) and the female percentage in the labour force (FPLF) are the significant variables in the model, as indicated by the p-values of 0.00, 0.00 and 0.02, respectively. Although the percentage of variation in fertility explained by this model is very high, about 92%, and the model is significant according to the F-ratio of 112.64, it is more likely that the insignificance of many individual regressors is affected by the problem(s) of heteroscedasticity and/or multicollinearity.

To confirm the existence of heteroscedasticity or otherwise, we are going to apply Breusch-Pagan test for heteroscedasticiy. The regression of the estimated variance of the disturbance term on the socio-economic variables, shows that the explained sum of squares (ESS) turned out to be 25.547. Accordingly, the ESS/2 (=12.7735) has a probability value of 0.186 when compared with the chi-squared value under 9 degrees of freedom. Hence the evidence about the existence of heteroscedasticity, though suggestive, is not strong enough to be significant at conventional sizes of test such as 5% or 1%. However, the result of this test suggests that the variance of the error term in proportional to ALRM (ignoring the insignificant terms). Accordingly, we divide the original model through by the √ALRM and obtain the new regression given by

$$\log TFR'^{1} = 0.184' + 0.000363\ ALRF' + 0.000689\ PPU' - 0.00170\ FPLF'$$
$$(0.12) \quad (0.13) \qquad (0.11) \qquad (0.03)$$
$$+ 0.00116\ PLFA' - 0.00454\ PCP' + 0.000656\ PPHS'$$
$$(0.07) \qquad (0.00) \qquad (0.09)$$
$$+ 0.280\ \log IMR' + 0.0070\ \log RPCI'$$
$$(0.00) \qquad (0.16)$$
$$F\text{-ratio} = 1031.62$$
$$n = 104\ ,\ df = 95\ ,\ s = 0.009006$$

Where inside the brackets are the p-values of the corresponding coefficients. But despite the high value of the F-ratio, the model does not work to remove completely the heteroscedasticity problem. So, we need to consider a general form of heteroscedasticity, suggested by Stewart and Wallis(1981), where the error variance is proportional to the function of all the explanatory variables, that is

$$\sigma_i^2 = b0 + b1\ ALRF + b2\ FPLF + b3\ \log RPCI + b4\ PPHS + b5\ PLFA + b6\ \log IMR + b7\ PPU + b8\ PCP + b9\ ALRM$$

We then use the regression equation of the absolute values of the residuals from the original equation in order to obtain estimates of b's and hence $\sigma i2$. Dividing through, then, the original equation by σ_i, we came with the transformed equation by OLS:

$$\log TFR''^{2} = 0.000142'' + 0.000396\ ALRF'' + 0.000187\ PPU''$$
$$(0.16) \qquad (0.14) \qquad (0.15)$$
$$- 0.0956\ FPLF'' + 0.000951\ PLFA'' - 0.00463\ PCP''$$

[1]For any term ending with "'", this means the term is divided by $\sqrt{ALRM}$.

[2]For any term ending with "''", this means the term is divided by σ_i.

(0.02) (0.05) (0.00)

+ 0.000466 PPHS" + 0.309 logIMR" + 0.0568 logRPCI"

(0.11) (0.00) (0.02)

F-ratio = 1509.45

n = 104 , df = 95 , s = 1.321

Where inside the brackets are the p-values of the corresponding coefficients. With an F-ratio of 1509.45, the model now is not only very significant but more powerful than before. According to the Breusch-Pagan test this model is better than the previous one in removing the heteroscedasticity problem. However, we do need to search, using some stepwise procedures, for a model which is parsimonious and theoretically satisfactory, while including only variables which achieve some reasonable level of statistical significance. Such a model is

logTFR" = 0.322325 logIMR" - 0.001136 FPLF" - 0.004594 PCP"

(0.00) (0.03) (0.00)

+ 0.081956 logRPCI"

(0.00)

F-ratio = 3327.16

n = 104 , df = 100 , s = 1.337

Where inside the brackets are the p-values of the corresponding coefficients. The model is extremely statistically significant overall, as indicated by the high value of F-ratio (3327.16) when compared with the tabulated F under 3 and 100 degrees of freedom. From a purely statistical viewpoint, the estimated regression model fits the data quite well. All the explanatory variables are now very statistically significant, according to the t-values of their corresponding coefficients. As expected, the

coefficients of PCP" and FPLF" are negative showing their relationship with fertility. Similarly, the positive coefficient of logIMR" confirmed what we said earlier about their direct relationship with fertility. However, the sign of the coefficient of logRPCI" turned out to be positive but still it is not a surprise. According to UN (2007), the rich people in many communities have more children than the poor.

Keeping all other variables constant, a one percent point increase in PCP is associated with 0.4594% reduction in the TFR. Similar comments can be said for the other variables in the model. We need, once more, to check whether this model satisfies the assumptions of normality, linearity, homoscedasticity, etc.

In order to test whether there is a difference or not between the two groups of countries, which we specified before, we introduce, again, new dummy variable: DlogIMR", DlogRPCI", DPCP" and DFPLF". They will be acting to differentiate between the slope coefficients of logIMR", logRPCI", PCP" and FPLF", respectively, in the two groups. The regression equation thus obtained is

$$\begin{aligned}\log TFR'' = &- 0.000258\ FPLF'' + 0.00293\ DFPLF'' - 0.00459\ PCP'' \\ &\quad (0.20) \qquad\qquad (0.11) \qquad\qquad (0.00) \\ &+ 0.00338\ DPCP'' + 0.299\ logIMR'' - 0.0991\ DlogIMR'' \\ &\quad (0.03) \qquad\qquad (0.00) \qquad\qquad (0.10) \\ &+ 0.0890\ log\ RPCI'' - 0.0810\ DlogRPCI'' \\ &\quad (0.00) \qquad\qquad (0.03)\end{aligned}$$

F-ratio 1949.33

$$n = 104 , df = 96 , s = 1.233$$

Where inside the brackets are the p-values of the corresponding coefficients. The model shows that the coefficients related to the variables: DPCP" and DlogRPCI" are statistically significant, indicating that there is a difference between the developing and the developed countries as far as the effect of PCP and logRPCI are concerned. In other words, a one percent increase in PCP is associated with 0.333% reduction in the log of the TFR more for the developed countries than for the developing ones. Similarly, a one percent point increase in the log of the RPCI is associated with a reduction of 8.1% in the log of the TFR less for the developed countries than for the developing countries. With the exception of the FPLF, all the variables are strongly statistically significant for the developing group.

8- Fertility and Factor Analysis

Factor analysis is used here to identify a relatively small number of factors that can be used to represent relationships among the socio-economic variables. The aim is to see if we can identify separate economic, social and demographic dimensions from these variables. The basic assumption of factor analysis is that these underlying dimensions, or factors, can be used to explain complex phenomena. Observed correlations between the variables result from their sharing these factors. Each variable, then, is expressed as a linear combination of factors, called common factors, which are not actually observed.

To help us decide how many factors we need to represent the data, it is helpful to examine the percentage of the total variance explained by each. The total variance is the sum of the variance of each variable. For

simplicity, all variables and factors are expressed in standardized form, with a zero mean and a unit variance.

Using the principal component method for extraction, and from the initial statistics for each factor along with the variance containing the variance explained by each factor, we found that the linear combination formed by the first factor has a variance (eigenvalue) of 9.67, which is about 74.4% of the total variance. Almost 85% of the total variance is attributable to the first two factors. The remaining factors together account for 15% of the total variance. Thus a model with two factors may be adequate to represent the data. The two extracted factors can then be expressed from the observed variables as

$$\begin{aligned} \text{FACTOR1} = {} & 0.94704 \log \text{RPCI} + 0.86616\ \text{ALRM} \\ & + 0.86247\ \text{ALRF} + 0.83990\ \text{PPHS} \\ & + 0.87071\ \text{PPU} - 0.93379 \log \text{IMR} \\ & - 0.89630\ \text{PCP} - 0.89247 \log \text{TFR} \\ & - 0.93663\ \text{PLFA} \end{aligned}$$

$$\text{FACTOR2} = 0.95680\ \text{FPLF}$$

It remains for us, then, to say that : the first factor could be interpreted as a general index of development and the second factor is just a measure of the female participation in the labour force.

9- Summary

This study has traced the effect of the economic and social factors on fertility behaviour. It is believed that the reduction in fertility which have been experienced by countries in all over the world is due to the general improvement in these economic and social conditions. The

percentage of contraceptive prevalence (PCP), the infant mortality rate (IMR), the real per capita income (RPCI), the female percentage in the labour force (FPLF), the adult literacy rate for males (ALRM), the adult literacy rate for females (ALRF), the percentage of the labour force in agriculture (PLFA), the percentage of population living in urban areas (PPU), and the percentage of population with access to health services (PPHS); are the variables which are suggested as determinants of fertility behaviour.

The Results showed that, and with the exception of the female participation in the labour force, all other variables under study showed an extreme significant association with the total fertility rate (the dependent variable), with correlation coefficients greater than and equal to 0.7 for all. The female percentage in the labour force is insignificant. The signs of the correlation coefficients of the total fertility rate and the percentage of the labour force in agriculture were positive confirming the direct relationship of these two variables with fertility behaviour. The rest of the variables assured their negative association with fertility. As far as the multiple linear relationship is concerned, fertility behaviour was considerably affected by all the variables except the percentage of population living in urban areas and the percentage of population having access to health services. These variables explained almost all of the variations in fertility behaviour. The percentage of contraceptive prevalence was the most important variable among these variables. It explained more than 86% of the fertility change, followed in the importance by the infant mortality rate, the reciprocal of the female percentage in the labour force, the adult literacy rate for females, the percentage of the labour force in agriculture, the log of the real per capita income and the adult literacy rate for males.

These variables, however, turned out to be playing less role in the developed countries than in the developing countries. This could be for the reason that the data we used do not vary so much in the group of the developed countries.

The factor analysis technique resulted in two factors being extracted: the second factor is related to the female percentage in the labour force whereas the the first factor is strongly related to all other variables. It came straight away that total fertility is highy represented by a factor along with the the socio-economic variables. So factor analysis confirmed the great association between the socio-economic variables and mortality and fertility behaviours.

It is therefore possible for the further reductions in ferility to occur with economic development and consequently improving health and medical technology, along with the better diet beside the greater educational attainment and awareness of health protection as an auxiliary factor. For further decline in fertility levels, it is very important, therefore, to rely heavily on birth control methods (including the contraceptives) since they proved to be responsible for most of the reduction in fertility behaviour, with the aid of education and consciousness of child care.

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