DIFFERENTIAL FERTILITY BY OCCUPATIONAL GROUPS IN THE PHILIPPINES

By

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1. INTRODUCTION

Most of the so called underdeveloped countries in the ECAFE region which till recently had only slow rates of growth have started experiencing rather rapid rates of growth of their populations. Mortality which was high was holding in check the rapid rise in population consequent on the rather very high birth rates. Migration also played some little part in easing population pressures in some of these countries in the past. But in the altered set up of today international migration as a safety value for population pressure may not be expected to be very important.

Immediately after World War II due to the changed political climate in most of these countries, more stress has been put on improving public health and other life saving facilities, especially facilities for infant and maternal care. Again the availability of cheap and efficient drugs, improved sanitation, drainage, water supply, etc., stress on education and literacy, the raising of the level of the living of the people, rousing of the general health consciousness among the mass of the people and to a large extent over all measures like the control and eradication of mosquitos and other disease carrying organisms have resulted in drastic reductions in the rates of mortality in several of these countries. Ceylon, Malaya, Singapore and Tai-

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wan are some of the countries which have experienced very large reductions in the mortality and morbidity rates. The other countries like the Philippines also have embarked on measures to improve the health status of the population. The effect of this improvement in the health status of the population is to a large extent reflected in the rather high annual rate of growth of population of 3.2% in the Philippines which has been brought out by the Census of 1960.

Similar patterns of population growth have been observed in the past among the Western countries immediately after the industrial revolution. But whereas in these countries this fall in the death rate was followed after a period of years by a rapid fall in the birth rate also, there has as yet been no indication in most of the countries of this region (perhaps Japan is an exception) of a fall in the birth rate. The time lag is too short to base conclusions but certain indications could be taken as evidences of the statement.

Whereas the declining death rate in most of these countries has been brought about by the efforts of the governments, it will require the efforts of the individuals to control and curtail the rather high birth rates. In the European experience the industrial urban educated worker feeling the advantage and necessity of small families started the movement which was soon picked up by the other sections of the population till it permeated the entire society. Thus indications of differential fertility by socio-economic groups could be taken as a measure of the future decline in fertility.

There is little sign as yet of any major rural-urban differences in fertility patterns in most ECAFE countries [2, 3, 4, 5, 12, 13, 14, 15, 16]. The results of some available studies have not indicated consistent differences between the rural and urban areas. Whereas some studies have found rural levels to be higher than the urban levels, there are a few other studies which have reported the reverse [10, 14]. Recently a study in the Philippines by Jupp [9] has observed certain indications or urban rural differentials. But even she is a little cautious in interpreting the implication of the study. She concludes

"any conclusion can therefore, be only tentative in nature: The evidence does give some support to the existence of urban-rural fertility differentials, and at least in Manila married women seem to have favoured a somewhat smaller family than that which has been current in rural areas." It should be emphasized that the evidence is not conclusive, and should be reviewed in the light of the other relevant data. Studies of the other relevant data. Studies of the relationship between family size and income in each area might, for example, indicate differential which would support the evidence of the data from the May 1956 Survey."

Again socio economic differentials in fertility in the ECAFE region also have not been pronounced and consistent [1, 2, 4 7, 8, 10, 16].

In any case systematic studies of the differentials in fertility levels by socio-economic characteristics are very important to focus attention on the future expected course of the most important demographic variable-fertility.

A systematic study of differential fertility by various characteristics would, however, require much more detailed data than is usually made available by the census results. The registration data of vital events like births, marriages, divorce, etc. could be of immense use in this study. But in the case of registration data the draw back of selective under registration of these events could introduce bias in our results and conclusions. This draw-back could to a certain extent be minimized by a well designed and controlled sample inquiry. Even in the sample enquiry, however well-planned and executed it may be, the usual errors on age reporting, income and social status reporting, etc. would come in and vitiate the result to a certain extent. Added to this is the effect of sampling errors on the estimate based on the samples. The analysis of the data and the interpretation of the results should be based on an assessment of the sampling size and plan.

In this paper a study of differential fertility by occupational groups from, data obtained from, four barrios in the Philippines has been carried out.

2. THE DATA

The data for the study from four barrios (Bagani, Dayap, Lawy and Gatbuca) in the Philippines. Table 1 gives the data. The number of women by five year of age and the number of children born to them by occupation of husbands are also given. Three occupational groups, farmers, farm labourers and skilled labourers, have been declineated and the data tabulated for these groups separately.

3. METHODS OF ANALYSIS OF THE DATA

From the data given in Table 1 we can calculate the age specific cumulative fertility rates of the 3 occupation groups. Tables 2 and 3 give respectively the 10 year and 5 year specific rates. Table 2 also gives the variance of the numbers of children for the 10 year age groups of women in the 3 occupational groups. From Table 2, it can be seen that the mean and variance are almost equal for each age group. This can also be inferred from the way the Table 1 is presented. It can be seen that within each age group for any occupational group, the distribution is Poissonian.

Table 2.

Means and Variances of the Frequency Distribution of Table 1

Age of Mother	Farmers		Farm Labourers		Skilled Labourers	
	Mean	Variance	Mean	Variance	Mean	Variance
15-24	1.7	1.5	1.6	1.8	1.7	3.3
25-34	4.2	3.8	3.8	4.3	3.8	4.5
35-44	6.7	6.9	6.4	5.3	6.4	7.4

Table 3.

Table showing the Average Number of Children Ever Born to Mothers of Different Ages.

Age of Mother	Average Number of Children Ever Born		
	Farmers	Farm Labourers	Skilled Labourers
15-19	1.60	0.67	0.00
20-24	1.77	1.93	1.90
25-29	3.33	3.42	3.28
30-34	5.17	4.27	4.25
35-39	6.31	6.20	6.00
40-44	7.02	6.91	7.18

Thus we see that the usual t and F tests for testing for differences in fertility between the groups are inapplicable as the mean and variance are very highly positively correlated.

We shall approach the solution to the problem in two alternate ways. Which method is better is to be decided only on the basis of their operating characteristics. We shall apply both the methods and shall not indicate which is better as the operating characteristics of these tests are still under investigation.

Since the mean and variance are almost equal within each age group, we may apply the χ^2 statistics defined as:

$$\chi_r^2 = \sum_{i=1}^{k} \left(\frac{O_{ri} - E_{ri}}{E_{ri}} \right)^2$$

where K is the number of ocupational groups under consideration and r denotes the age group. O_{ri} and E_{ri} denote respectively the observed and expected numbers of children for the r^{th} age group and i^{th} occupation group.

We accept that the fertility performances in any specific age group r of the 3 groups are equal if and only if (iff)

$$\chi_T^2 \leq \chi_{r,\alpha}^2$$

Thus we shall accept that there is no diferrences between the 3 occupational groups at all ages, iff

$$\chi_T^2 \leq \chi_{T,\alpha}^2 \quad \text{for all } r = 1, 2, \ldots\ldots m$$

i.e., iff

$$x_r^2 \leq U_\alpha \quad \text{where } U_a \text{ is the upper } a\% \text{ point of}$$

the largest x^2 variable with k-1 degrees of freedom based on m variates [11]. Here m is the number of age groups.

This is the first approach. The second approach is as follows: Since the means for each age group denotes the cumulated value up to that age, the curve of the means is an increasing one with a start at zero and an assymptotic value after the highest age at which child bearing stops. Also it can be noticed that (1) the means and standard deviations of the number of children ever born calculated for the different age groups are highly positively correlated, (2) the differences of the reciprocals of the averages in the different age groups are changing by almost a constant percentage of the average of two consecutive first differences, (3) the curve of the average number of children ever born plotted against age follows an S shaped

curve. All these point out to the fitting of a suitable exponential curve to the data. This idea is fortified by the fact that child bearing performances are allied to the problems of organic growth which in turn is representable by a suitable organic growth curve. Again the rate of growth is fast when the level is low followed by a slow rate of growth and high levels or the rate of growth is continually increasing in the initial stages maintaining this high rate of growth till high levels which suggests that specifically the logistic growth curve,

$$y_r = \frac{c}{1 + e^{a + br}}$$

where y_r is the number of children ever born to women aged r years, should give a good fit to the data on hand. On the basis of this curve for the occupation groups the following analysis are possible.

(A) the value of 'c' is the assymptotic value of the curve or in this situation it gives the estimate of the mean number of children ever born to mother of completed fertility. Thus comparison of the values of 'c' for the diffrent occupation groups will bring forward indications of differential fertility.

(B) the value of 'b' is the inherent rate of growth of the average number of children born. Thus comparison of the values of 'b' for the different occupation groups will give indications of differential rates of growth for the different groups.

The logistic curve as given above seems to fit the data well. But the difficulty is with regard to simultaneous tests of the parameters in the curve.

Partly to avoid this and partly to utilize the knowledge that the logistic curve fitted for the intermediate range is almost independent of the assymptotic value 'c' [6] we have proceeded as follows:

Let $\log_e \frac{c - y_r}{y_r} = a + br$ so that $y_r = \frac{c}{1 + e^{a + br}}$

Thus if c is chosen as a known quantity then a and b could be obtained by the usual method of least squares. Considering $Z_r = \frac{c - y_r}{y_r}$ as new variables we fit $Z_r = A B^r$ or e^{a+br} and obtain a and b. Then by th eusual test procedures we test the hypothesis $a_1 = a_2 = \ldots\ldots\ldots = a_k$

and $b_1 = b_2 = \ldots\ldots\ldots = b_k$ for the k occupation groups.

Observed and expected numbers of ch

Age	Occupation	Farmers			
		No. of women	No. of children		No. of
			Observed	Expected	
15-19		8	12	7	
20-24		65	115	120	
25-29		81	270	271	
30-34		70	362	332	
35-39		68	429	423	
40-44		64	429	431	

$$\chi_1^2 = 6.26$$

$$\chi_2^2 = 0.45$$

$$\chi_3^2 = 0.13$$

$$\chi_4^2 = 5.81$$

$$\chi_5^2 = 0.27$$

$$\chi^2 = 0.06$$

f mother and by occupation of husbands

ers		Skilled Labourers			Total	
of children		No. of women	No. of children		No. of women	No. of children
ed	Expected		Observed	Expected		
13		2	0	2	25	22
77		19	36	35	126	232
120		25	82	84	142	475
157		28	119	133	131	622
187		24	144	149	122	769
74		10	67	67	85	572

Age of mother	Number of Children													
	Farmers													
	0	1	2	3	4	5	6	7	8	9	10	11	12 & over	Total
15–19	1	3	3	1	–	–	–	–	–	–	–	–	–	8
20–24	11	16	23	9	5	–	1	–	–	–	–	–	–	65
25–29	1	5	19	18	19	17	2	–	–	–	–	–	–	81
30–34	2	2	4	3	16	10	14	11	6	–	2	–	–	70
35–39	1	–	2	3	9	9	12	10	12	5	3	2	–	68
40–44	3	–	5	1	2	7	6	11	13	8	4	4	4	68
45–49	2	2	1	2	2	8	10	5	9	6	4	6	3	60
Total	21	28	57	37	53	51	45	37	40	19	13	12	7	420

Age of mother	Number of Children													
	Farm Labourers													
	0	1	2	3	4	5	6	7	8	9	10	11	12 & over	Total
15–19	8	6	–	–	1	–	–	–	–	–	–	–	–	15
20–24	6	11	11	5	4	1	–	–	–	–	–	–	–	42
25–29	3	4	5	9	4	5	3	2	–	1	–	–	–	36
30–34	1	2	3	5	5	10	4	1	1	1	–	–	–	33
35–39	1	–	1	–	3	6	4	9	2	2	1	1	–	30
40–44	–	–	–	–	3	2	–	1	1	1	3	–	–	11
45–49	–	1	–	1	2	1	1	1	2	2	1	1	2	15
Total	19	24	20	24	22	25	12	14	6	7	5	2	2	182

Age of mother	Number of Children													
	Skilled Labourers													
	0	1	2	3	4	5	6	7	8	9	10	11	12 & over	Total
15–19	2	–	–	–	–	–	–	–	–	–	–	–	–	2
20–24	5	4	4	4	–	1	–	1	–	–	–	–	–	19
25–29	2	–	4	9	5	4	–	1	–	–	–	–	–	25
30–34	3	3	1	2	3	8	3	3	1	1	–	–	–	28
35–39	1	–	1	1	3	7	6	5	1	2	2	–	–	24
40–44	1	–	–	–	1	–	3	–	3	–	1	1	1	11
45–49	1	–	–	–	–	1	4	2	1	1	1	:	–	12
Total	15	7	10	16	12	16	16	12	6	4	4	2	:	121

* Source: Survey of Households in Selected Barrios in the Philippines [17]

4. APPLICATION OF THE TECHNIQUES OF SECTION 3 TO THE ANALYSIS OF THE DATA.

Table 4 gives the observed and expected numbers of children by age of mother and occupation of husbands. The x^2 values for each age group are given at the bottom of the table. From this it is obvious that the largest x^2 value from the sample is 6.26. The tabulated upper 5% value of the largest x^2 with 2 degrees of freedom and based on 6 x^2 variates is 9.52. Thus we see that at the 5% level of significance there is no significant differences between the 3 occupation groups with regard to their fertility performances at all ages.

Table 5 gives the expected values based on 4 fitted curves. The first one is the simple exponential curve, the second one is the general logistic curve and the third and fourth are respectively logistic curves with the upper assymptotic value fixed as 8 and 10.

The exponential curve is not of much use as the value goes on increasing which is impossible with data of this type. Hence it is only given to illustrate its inapplicability in this situation. The general logistic curve fits the data on hand quite well. But problems of simultaneous testing of the parameters will come in. Thus the modified logistic with the upper assymptotic value assumed to be known is used. The upper assymptotic values of of 8 and 10 are used to illustrate the range of variation introduced into the expected values by such big variation in the assymptotic value. The difference is not much.

Since the fit seems to be close with the value of 8, we have analyzed the data assuming that $\frac{8-Y_r}{Y_r} = AB^r$

Defining Y_{ir} = average number of children born to women in i^{th} occupation group in the j^{th} group or to women aged say t_{ij} and putting $z_{ij} = \log_e \frac{8 - y_{ij}}{y_{ij}}$ we get

$$z_{ij} = a_i + b_i t_{ij}$$

To test the hypothesis that these regression lines have equal slopes i.e.

$$H_1 : b_1 = b_2 = b_3 \text{ we calculate}$$

$$\hat{b}_i = \frac{\sum_j (z_{ij} - z_{i.})(t_{ij} - t_{i.})}{\sum_j (t_{ij} - t_{i.})^2}$$

$$\hat{b} = \frac{\sum_i \sum_j (z_{ij} - z_{i.})(t_{ij} - t_{i.})}{\sum_i \sum_j (t_{ij} - t_{i.})^2}$$

and accept that the b_i's are equal if and only if

$$F_{k-1,n-2k} = \frac{\sum_i (\hat{b}_i - \hat{b})^2 \sum_j (t_{ij} - t_{i.})^2}{\sum_i \sum_j \left[(z_{ij} - z_{i.}) - b_i(t_{ij} - t_{i.})\right]^2} \cdot \frac{n - 2k}{k - 1} \leq F_\alpha ;$$

where F_α is the upper α% point of the F distribution with $k - 1$ and $n - 2k$ degrees of freedom.

For the data on hand

$$\hat{b}_1 = -0.3204, \qquad \hat{b}_2 = -0.3572,$$
$$\hat{b}_3 = -0.3538, \qquad \hat{b} = -0.3421,$$

and $$F_{2,\,14} = \frac{0.0136}{0.0903}\,\frac{14}{2} = 1.05$$

which is less than 3.74 the upper 5% point of the F distribution with 2 and 14 degrees of freedom. Hence we accept that the b_i's are equal or that the slopes of the 3 regression lines are equal. The rates of growth of the 3 growth curves are thus found to be not significant by different from each other.

Now to test whether the ai's are equal to calculate

$$\hat{b}_o = \frac{\sum_i \sum_j (z_{ij} - z_{i.})(t_{ij} - t_{i.})}{\sum_i \sum_j (t_{ij} - t_{i.})^2}$$

$$\hat{\hat{b}}_o = \frac{\sum_i \sum_j (z_{ij} - z_{i.})(t_{ij} - t_{i.})}{\sum_i \sum_j (t_{ij} - t_{i.})^2}$$

and accept that the a_i's are equal if and only if

$$F_{k-1,n-k-1} = \frac{\Sigma\Sigma_{ij}\left[(z_{ij}-z_{i.})+b_o(t_{ij}-t_{i.})-\hat{b}_o(t_{ij}-t_{i.})\right]^2}{\sum_i \sum_j \left[(z_{ij} - z_{i.}) - \hat{b}_o(t_{ij} - t_{i.})\right]^2}$$

$$\frac{n-k-1}{k-1} \leq F_\alpha ,$$

where F_α is the upper α% point of the F distribution with $k-1$ and $n-k-1$ degrees of freedom.

For the data on hand

$$\hat{b}_o = -0.3421, \qquad \hat{\hat{b}}_o = -0.3415$$

and $$F_{2,\,13} = \frac{0.0327}{0.1049} \cdot \frac{13}{2} = 2.03$$

which is less than 3.80 the upper 5% point of the F distribution with 2 and 13 degrees of freedom.

Hence we accept that the a_i's are equal.

Thus we see no evidence of differentials in the fertility performances of the 3 occupation groups on the basis of this test also.

5. Conclusion:

From the above analysis we come to the conclusion that on the basis of this data there is no indication of occupational differentials in fertility performances. But looking at the data a little more critically it can be seen that the expected numbers of children to farmers is a little less than the observed whereas in the other two cases it is a little more which implies that the performance of the farmers group is a little more than that expected on the assumption of no fertility differentials. The overall x^2 test is not able to bring forward these small differentials perhaps due to the small sample size involved. Again by fitting the curve $\frac{8-y_r}{y_r} = AB^r$ we find that the inherent rate of growth in the case of farmers is larger than that for the other two groups even though the overall F test indicates no significance.

It seems larger sample size may bring forward differentials by either procedure. In any case even if differentials do exist between the occupation groups, the range of differences is very little indeed. A more detailed study on this will be interesting and rewarding.

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