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AN EMPIRICAL ANALYSIS OF A DISEQUILIBRIUM MODEL OF FERTILITY BEHAVIOR AND THE THRESHOLD HYPOTHESIS: 1973 PHILIPPINES

by

Vicente Paqueo and Joseph Fernandez

Abstract

This paper examines a model of fertility behavior in which some women have excess capacity to bear children, while others have excess demand. This idea, which has not received adequate attention in econometric analyses of fertility behavior with the exception of Encarnacion's studies, underlies current explanations of certain demographic phenomena including the persistence of high birth rates in LDCs that have achieved low mortality rates.

In this study, the implications of the model regarding the fertility effect of life expectancy are examined and tested. In conformity with the model's prediction, life expectancy appears to have an insignificant effect on the fertility of wives with educational attainment below elementary grade and family income below ₱2,500 in 1973. Among higher income and more educated women, however, the effect of life expectancy at birth is significantly negative and the estimated elasticities appear to be in the order of -.72 and -1.15.

The model was also tested by examining age at marriage. The hypothesis is that individuals marry later the larger the expected excess capacity to bear children to minimize unwanted births. If the model under consideration is correct, the conjectures, which are confirmed by the empirical results, are: (1) education above elementary should have a significantly positively influence on the age at marriage inasmuch as excess capacity is expected to be larger the more educated the women is; (2) below elementary grade, however, it should have no effect since women in this situation are expected to have excess demand for births.

AN EMPIRICAL ANALYSIS OF A DISEQUILIBRIUM MODEL OF FERTILITY BEHAVIOR AND THE THRESHOLD HYPOTHESIS: 1973 PHILIPPINES

by Vicente Paqueo and Joseph Fernandez[1/]

One of the most important hypotheses in population studies is the idea that mortality reduction leads to a decline in fertility. This idea underlies traditional demographic transition theory and appears to be widely, though not universally, accepted. Empirical support for the hypothesis comes from two sources. One is the historical experience of developed countries; the other from cross-section studies showing a positive correlation between mortality and fertility.

Contrary to the experience of developed countries, however, as well as findings from cross-section data the birth rate in the Philippines as in other LDCs, which is still quite high, failed to match the rapid decline in mortality rate that has been achieved. This phenomenon is puzzling, especially when one considers that, as indicated by rising education, per capita GNP and urbanization, the

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We wish to acknowledge CAMS' financial support for this research, which is part of a larger comparative study of the fertility behavior of married women in selected ASEAN countries. We are indebted to Ms. Felice Llamas for computer programming and to Fr. Flieger for the data on provincial level life expectancy at birth.

Philippines has been undergoing a respectable rate of economic development, which is widely supposed to reinforce the transition from high to low birth rate that might be expected from mortality reduction. Consequently, it is necessary to clarify the fertility effects of mortality in relation to education, income, and urbanization.

The idea that a reduction in mortality lowers the birth rate has been used in part to justify additional expenditures on health programs. An important question in this regard, Preston (1975) has pointed out, is whether the quantitative influence of mortality on fertility is sufficiently large that the consequences on population growth can be safely ignored. New evidence on this question, he concludes, is not reassuring. Data, however, reveal that the quantitative importance of the mortality effect and the time lag involved vary quite substantially. The question is, what are some critical factors that would explain these variations? Aside from its obvious importance in explaining demographic transition, this issue is significant from the standpoint of policy in that, even if the effect of a mortality decline on population growth cannot be completely avoided, it can at least be minimized, if the conditions affecting the quantitative relationship between mortality and fertility is better understood.

This paper discusses some of the conditions under which reduction in mortality might not be followed by a significant fall in fertility. To this effect, we utilize Encarnacion's (1977) model, an analytical framework similar to that earlier proposed by Tabbarah (1971) and Easterlin (1975). In particular, we want to estimate the fertility effect of mortality and examine the hypothesis that, while beyond some level of income and education births are largely demand-determined, at lower levels the desired fertility of married woman in LDCs exceeds their capacity to produce children and, therefore, actual fertility is basically biologically determined. This idea, which has been advanced also by Kuznets (1977) and Preston (1975), underlies a current explanation for the failure of the birth rate to match the drastic reduction of the mortality rate in LDCs. Evidence for it, however, is still inconclusive.

In the following sections, the model is presented, the pertinent literature briefly reviewed and the hypotheses regarding the influence of mortality on fertility discussed. Next, we estimate the effect of provincial level life expectancy at birth on a sample of married women from the 1973 National Demographic Survey of the Philippines. Furthermore we analyze and test the implications of the model regarding age at marriage. In the final section, we summarize our findings and conclusions.

THE MODEL

Assume that the natural fertility rate of women (i.e., the number of live births that would be born to a woman if she were not controlling birth) is positively related with income. The reason for this is that with more income and, hence, better consumption of food and health care services women tend to be more fecund. This relationship is represented by the NF curve in Fig. 1. It can also be argued that desired number of children is a function of family income and the relationship, which is represented by the DFS curve , is inverse.

The interpretation of the often observed negative relationship between family income and fertility of women (mostly of developed economies) is a controversial topic in economic demography. Traditional economic theory suggests that as income rises the demand for goods, including children, normally increases. Since there is no reason to suppose that children are inferior "goods", the problem of explaining the negative correlation arose. An explanation originally proposed by Becker (1960) is that, assuming that both quantity and quality of children somehow enter in the objective function of parents and assuming further that children are given equal amounts of quality inputs, an increase in demand for quality

due to a larger income has the effect of increasing the price of having an extra child. In short, an income change generates not only a positive income effect but also a negative price (substitution) effect. Hence, in principle, it is possible that, if the latter is larger than the former, the net effect of income change is negative.[2/]

An alternative explanation, which is held by Leibenstein (1957), Duesenberry (1960) and Blake (1968), who rejected Becker's assumption that parents make choices regarding quantity and quality, centers on the argument that as income rises the social status of parents goes up and, hence, they must spend more per child as a matter largely of "social compulsion". Therefore, it is argued that since an additional child would cost more, the effect of an increase in income tends to be negative. This view, which has been criticized by Becker (1960) in that prices should generally be the same for all families regardless of income class in cross-section data, is reminiscent of Veblen's (1899) comment that the conspicuous consumption, and the consequent increased

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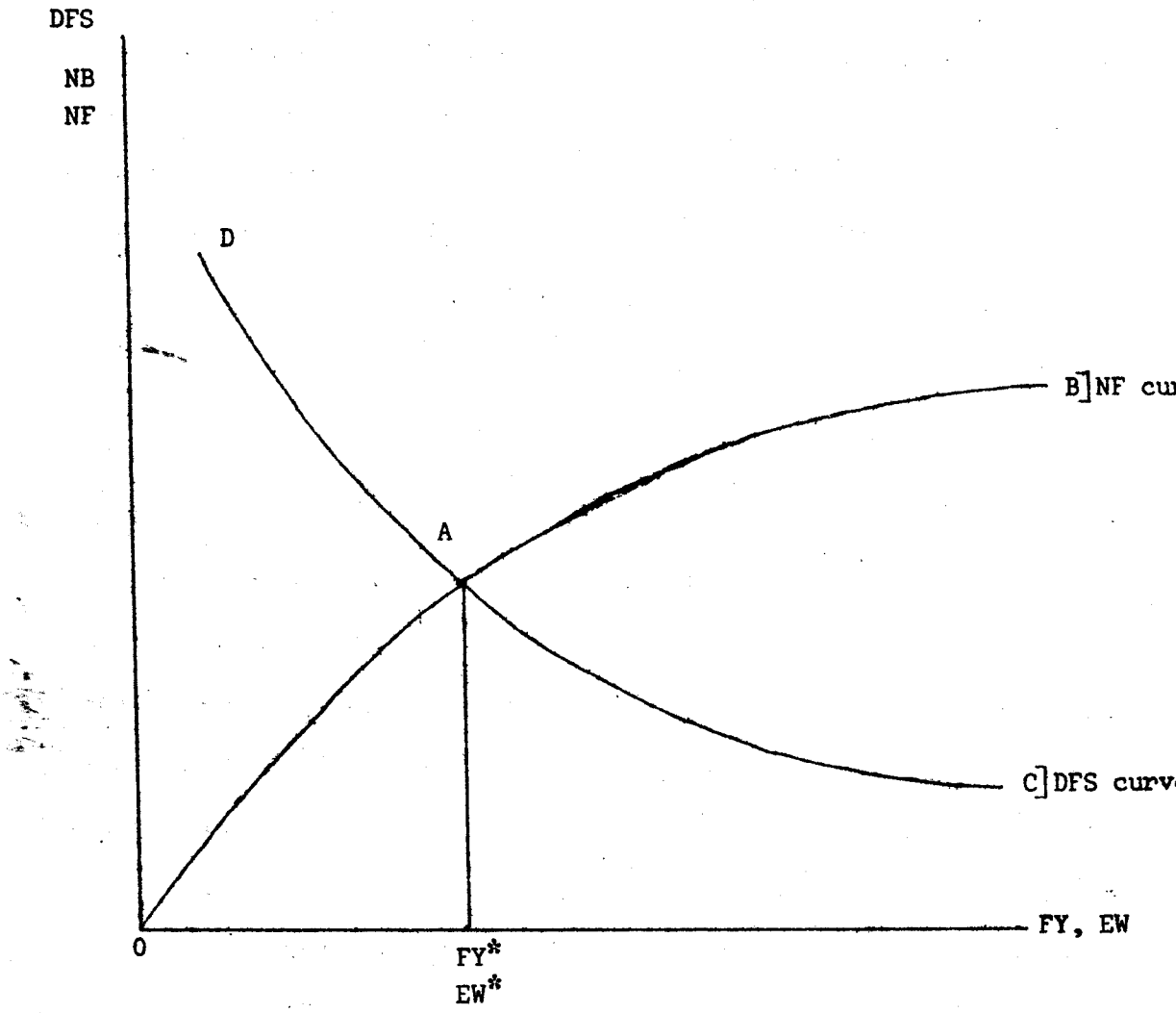
2/ In studies using the household production model, the effect of income depends on its source. The influence of husband's earnings and nonlabor income is positive, assuming that child services is a normal commodity. Wife's wage, however, is said to have not only an income effect but also a substitution effect. Hence, if the latter effect predominat the relationship between wife's income and fertility will be negative (see Willis 1973; Mincer 1963).

expense required in the reputable maintenance of a child is very considerable and acts as a powerful deterrent, "which," he writes, "is probably the most effectual of the Malthusian prudential checks" (p. 113).

The interpretation of the mechanism underlying the inverse relationship between income and fertility is very complex and there is no consensus on the matter. For our present purposes, however, it is sufficient to note that for sociological as well as economic reasons it is plausible to posit a negative causal relationship between income and desired family size.

Consider now Fig. 1. Suppose that initially the NF and DFS curves are OAB and DAC, respectively, then, at income level FY^* desired and natural fertility rates are equal. Below FY^* desired fertility is greater than the number of children couples are capable of producing. The relationship between actual fertility and income below FY^* is depicted by the line OA. Above FY^*, assuming that contraceptive methods and information are easily available so that there are no unwanted births, the effect of income on actual fertility would be indicated by the segment AC of the DFS curve. Hence, the actual fertility-income relationship would be indicated by the line OAC.

Figure 1. An Excess Demand and Supply Model of Fertility Behavior



The same model depicted in Fig. 1 can be used to illustrate the threshold hypothesis in regard the fertility effect of education. As with income, we assume that the effect of education on natural fertility is positive due to better health and nutrition. The curve for desired number of births is drawn as a decreasing function of wife's education as widely, though not universally, believed. This may be justified on several grounds. Education is a proxy variable for earning capacity. Therefore, an increase in education raises the opportunity cost of an additional birth and, hence, depresses demand for children. Furthermore, since the net cost of having a child is less when the cost of birth control is lower, more educated women are likely to desire less births inasmuch as education is positively correlated with knowledge of and access to birth control methods. Finally, education is likely to affect taste and it is reasonable to assume that parents would want at least the same level of education for their children as they have, if it is possible. Consequently, ceteris paribus, more educated women are likely to have a lower demand for children. Given these assumptions, Fig. 1 shows that below EW^* households have excess demand for births, while above it they have excess capacity. This suggests that the marginal effect of education is likely positive below some critical or threshold level of education (EW^*) and negative above it.

The model appears to conform very well with Philippine data. In an empirical study of the 1968 National Demographic Survey (NDS), Encarnacion (1974) found that the marginal effect of family income and education are positive below ₱1,500 and elementary level, respectively, but above these levels they tend to be negative. These findings are confirmed by studies using the 1973 NDS (Canlas and Encarnacion 1977; Paqueo 1978). The existence of income and education threshold effects, however, does not necessarily imply that below the thresholds fertility is effectively constrained by natural fertility. In particular, it is not inconsistent with the basic household production model. As Evenson (1978) has pointed out, "it is quite plausible that the net effect of a combined change in income and price of time of the mother will have a positive effect on fertility at low levels and negative effect at high levels. This is because the "shadow price" effect may increase at a faster rate than the income effect associated with a rise in income" (p. 12). In other words, Encarnacion's findings can be explained by economic demand theory without having to assume that the actual fertility of the poor and less educated are effectively constrained by natural fertility. For this reason, there is a need to further clarify the fertility behavior of Filipino wives, considering that the two interpretations have important but quite different implications. To do this, we examine the fertility effect of mortality rate and

its interaction with income and education.

THE FERTILITY EFFECT OF CHILD MORTALITY AND THE THRESHOLD HYPOTHESIS

In this section, we briefly review the hypotheses regarding the effect of a decline in mortality rate on fertility and the factors that affect it.

Notestein (1945, 1953) and Davis (1963) have argued that in pre-modern societies, where mortality was very high, norms and practices that favor high fertility evolved to ensure the survival of society. With the decline in mortality, therefore, the need to maintain a high birth rate is reduced. Hence, a fall in the birth rate is likely to follow a mortality decline. It has also been argued that couples in LDCs have a certain target number of surviving children (Heer 1966; Heer and Smith 1968). Parents might,therefore, be expected to replace a child death after its occurence. Sequential replacement of child deaths, however, may not be sufficient to ensure the achievement of the target inasmuch as some of them could occur after the wife's reproductive years. It has, therefore, been hypothesized that parents, apart from reacting to their own family experience of child mortality, want to have additiona births to allow for the possibility that replacement might no longer be feasible. In this regard, it is reasonable to assert

that the higher the mortality rate prevailing in the community the greater would be the uncertainty and, hence, the need to have a kind of "buffer stock". Consequently, one would expect fertility to be higher even among those families without child deaths. If it is further assumed that parents consider a shortfall more distressing than an excess of children, the elasticity of fertility with respect to mortalit may be greater than unity or over-compensatory.

The weakness of those hypotheses is that they assume some fixed target number of surviving children (DFS) and they are silent on the effect of mortality on it. In this connection, T.P. Schultz (1974) has argued that a decrease in the mortality rate reduces the expected cost of producing a surviving child. Therefore, he argues on the basis of economi demand theory that an increase in life expectancy might raise DFS. Applying the von Neumann-Morgenstern approach to the study of decision-making involving risks, O'Hara (1975) has shown that an exogenous decline in mortality rate generates systematic shifts in relative costs. Specifically, it reduces "both (1) the expected cost of quantity and quality of childre relative to other goods and (2) the expected cost of quality relative to quantity of children" (p. 1212). These shifts in relative costs might negatively influence fertility. However,

insofar as the expected income of the family becomes larger with less uncertainty, a reduction in mortality would also raise the demand for child services, making the net effect indeterminate.

An exogenous decline in mortality influences not only desired fertility but also the wife's fecundity in breastfeeding populations. Considering that lactation has a strong tendency to suppress ovulation, one might expect child survival to delay the next pregnancy. Therefore, a lower mortality rate tends to be accompanied by lower fecundity.

In general, a review of current findings indicate that there is a significantly positive correlation between mortality and fertility (T.P. Schultz 1976). A notable exception is Adelman (1963) who found the international cross-section correlation to be insignificant. Preston (1975), summarizing studies estimating the "replacement effect", concludes that:

> In most of the score of population for which data are available, there is some fertility response to an infant or child death in the family but in none of the populations is the response even half "complete". That is, most families are unable or unmotivated to replace a deceased child with another live birth, additional to those that would be expected in the absence of child death.

Flieger's (1975) analysis of the 1968 NDS data reveals "a

slight positive relationship between regional fertility (as measured by number of live births per mother aged 15-60) and the incidence of infant deaths. Greater Manila, the area with lowest fertility, displays the lowest level of infant deaths, while in high fertility areas child mortality is likewise high" (p. 112). Harman(1970), using multivariate analysis and the same data source, estimated the influence on subsequent household fertility of infant and child death and community level mortality rates. He concludes that "the safety factors due to infant and child mortality seem to be quite significant. Within the family's own experience, infant mortality is confirmed to have a larger impact on 'replacement' births than is child mortality. Perception of the risk of losing a child (as represented by the community infant safety factor) also has a significantly positive effect" (p. 35).

Preston (1975) has argued that at low levels of development the observed fertility effect of child death is a purely biological response. He advances two plausible explanations for the absence of a volitional replacement effect in this situation. He speculates that "either family size goals are not framed in terms of surviving number of children or the goals themselves are so high that child-

bearing at a near maximum rate would be required to reach them even in the absence of child deaths." In either case, he contends that "the type of reproductive motivation presumed by Heer and Smith could not be prevalent in those populations" (p. 193). He argues further that only when family size goals become sufficiently low can a substantial volitional response be expected.

A similar idea has been advanced by Encarnacion (1977). Consider Fig. 2 where:

$$NF = f(EW, FY) \qquad f_1, f_2 > 0$$

$$DFS = g(EW, FY) \qquad g_1, g_2 < 0$$

$$HOM = h(EW, FY) \qquad h_1, h_2 < 0$$

and NF = biological capacity to bear children; DFS = desired number of surviving children; HOM = child deaths; EW = wife's education; FY = family income.

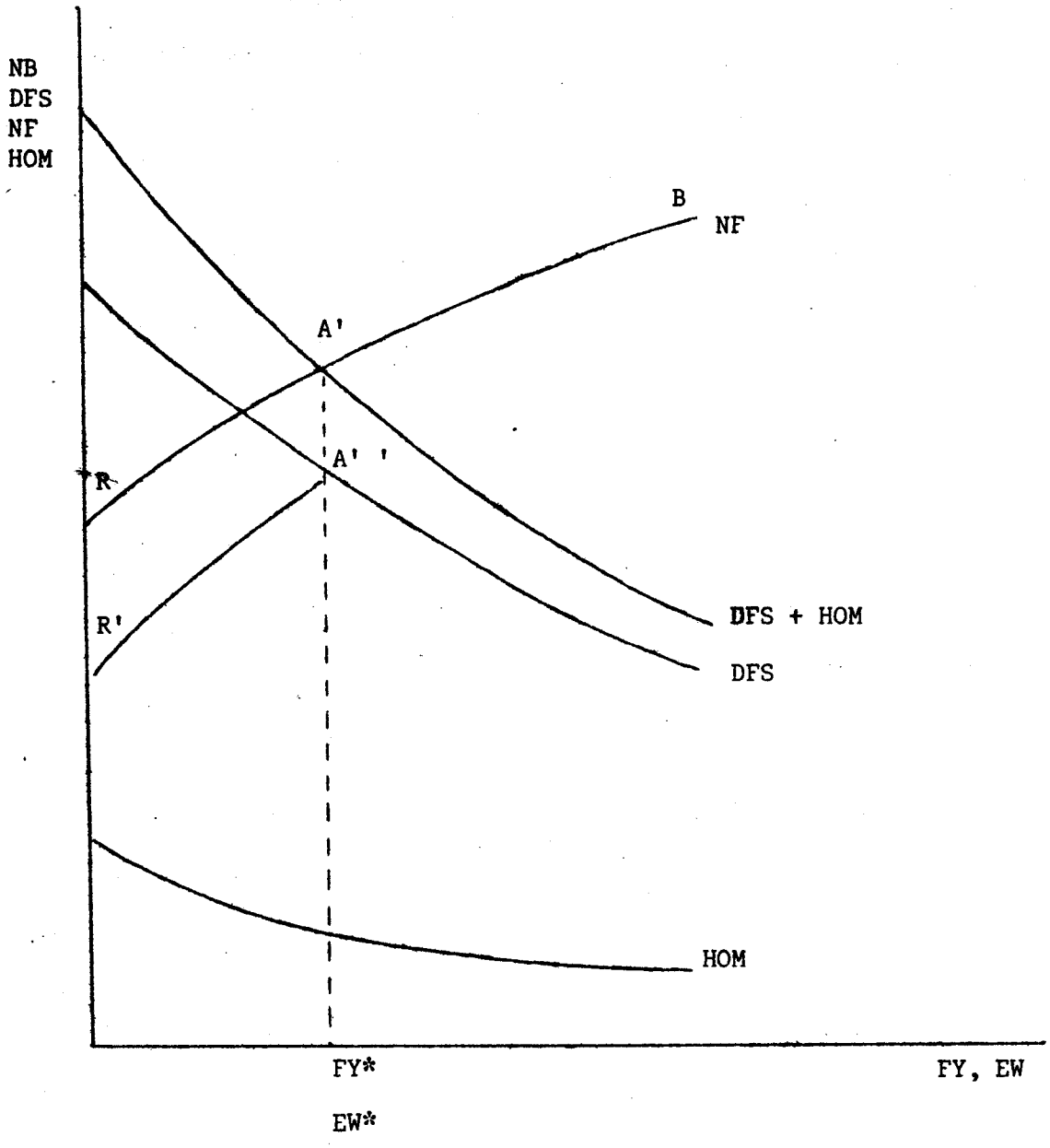
The number of children ever born (NB) is given by

$$NB = f(EW, FY) \qquad \text{for } FY < FY^* \text{ or } EW < EW^*$$

$$NB = g(EW, FY) + h(EW, FY) \qquad \text{for } FY \geq FY^* \text{ or } EW \geq EW^*$$

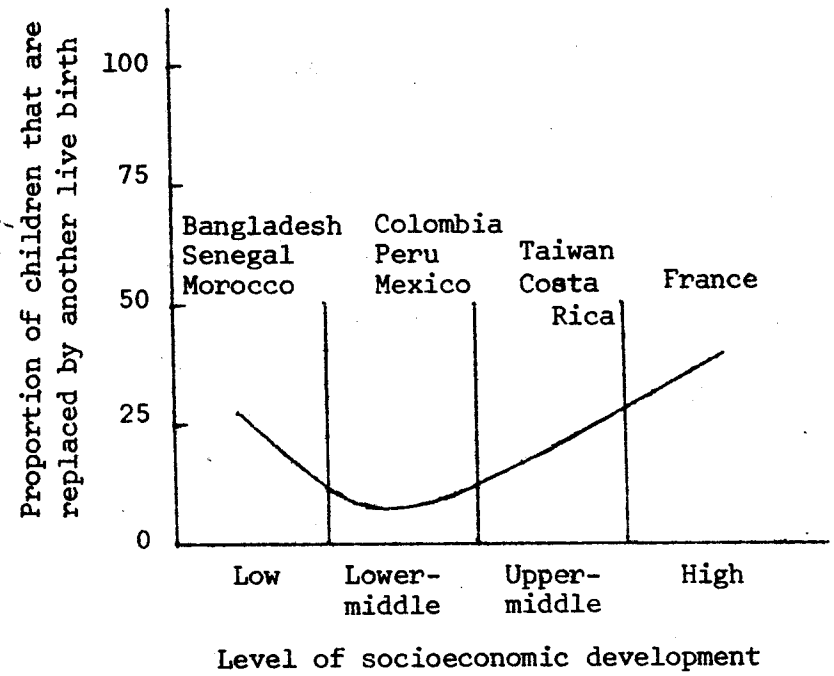
It could easily be seen that a downward shift in HOM curve would lower the desired number of births (DFS + HOM) curve to the same extent. Hence, Encarnacion (1977, 1979) conjectures

Figure 2. Encarnacion's Graphical Representation of the Relationship Between Fertility and Child Mortality



that families above the threshold would match the mortality decline fully with a reduction in fertility. On the assumption that the NF curve remains the same, he further predicts that the downward shift in the mortality curve would not influence actual number of births (NB). It would simply allow the couples to have more surviving children. The assumption, however, that an exogenous decline in child mortality would not affect NF is not realistic in view of the fact that, as discussed earlier, among breastfeeding populations child death tends to reduce post-partum sterility or, conversely, child survival biologically delays subsequent pregnancy. Consequently, one might expect a positive correlation between NB and HOM even among families below the threshold. Furthermore, the size of the effect of child death would be declining with income and education inasmuch as the rate of breastfeeding is negatively related with these variables. Therefore, if the fertility of women below the threshold is biologically determined, then the effect of child mortality should be less than unity and declining with income and education, while, among households above the threshold where NB is presumed to be demand-determined, it should be close to unity or even greater, if, in addition to the replacement motivation, couples want some "buffer stocks" as insurance and/or the desired number of surviving children decreases as a result of changes in

Figure 3. Approximate Extent to which Dead Children are Replaced in a Family



Source: Samuel Preston, "Health Programs and Population Growth," Population and Development Review. 1(2), December 1975.

relative prices. This explains, as Preston (1975) pointed out, the U-shaped curve relating the fertility effect of child death and level of development (see Fig. 3). We note, however, that an exogenous decline in mortality might be brought about in part by health programs that improve women's natural fertility like malaria control and maternal and child care which includes pre-natal care. Consequently, it is possible for the fertility effect of mortality to be positive, negative or zero.

EMPIRICAL RESULTS

This section discusses our empirical analysis of the influence of provincial level life expectancy at birth on household level fertility and its interaction with income and education.

The following variables and their notations are used in this study:

AM = age of the woman at marriage

CW_k = 1 if the woman belongs to age-cohort k,
0 otherwise; where k is coded as:

4 = age 15-19

5 = age 20-24

6 = age 25-29

7 = age 30-34

8 = age 35-39

9 = age 40-44

EW = educational level of the wife; coded as:

0 = no schooling

1 = finished 1 to 4 years of grade school

2 = finished 5 to 7 years of grade school

3 = finished 1 to 3 years of high school

4 = high school graduate

5 = finished 1 to 3 years of college

6 = college graduate

EW^* = threshold education taken to be 1.5

EWN = $\min(0, EW-EW^*)$

EWX = $\max(0, EW-EW^*)$

FY = annual family income in thousand pesos

FY^* = threshold income taken to be 2.5

FYN = $\min(0, FY-FY^*)$

FYX = $\max(0, FY-FY^*)$

LEX = male life expectancy at birth for a given provin

LPW = 1 if the wife is working, 0 otherwise

LOC = 1 if the location of residence is urban, 0 other

NB = number of live births the woman has had

Z_1 = 1 if $EW < EW^*$; zero otherwise

Z_2 = 1 if $EW \geq EW^*$; zero otherwise

LOC_j = 1 if wife has characteristic j; zero otherwise.

j coded as:

0 = 1 if rural and $EW < EW^*$; zero otherwise

1 = 1 if rural and $EW \geq EW^*$; zero otherwise

2 = 1 if urban and $EW < EW^*$; zero otherwise

3 = 1 if urban and $EW \geq EW^*$; zero otherwise

Except for life expectancy at birth our data base is the 1973 National Demographic Survey. This data set consists of observations based on a nationwide stratified random sample of 8,434 households conducted by the U.P. Population Institute in cooperation with the National Census and Statistics Office. Our indicator of community level mortality is provincial male life expectancy at birth, data for which were obtained from Flieger's 1965 provincial life tables. Only some 42 out of 70 provinces have available estimates of the male life expectancy at birth (see Table 4.1). Consequently, the sample of households under study is limited to those 42 provinces. It is further limited to nuclear families consisting of women belonging to the 15-44 age group, married only once and with husband present at the time of the survey. Finally, it included only those households with complete information on the educational

Table 4.1 Male Life Expectancy at Birth by Province: 1965[a/]

Province	Level[e/]	Type[f/]	Male Life Expectancy at Birth
Abra	15.56	II	53.270
Agusan del Norte[b/]	16.10	I	54.385
Agusan del Sur[b/]	16.10	I	54.385
Aklan	15.32	II	52.679
Albay	17.53	I	57.619
Antique	15.28	II	52.483
Batanes	15.68	IV	53.348
Bohol	15.53	IV	52.063
Bukidnon	15.46	II	52.987
Cagayan	15.36	II	52.688
Camarines Norte	14.86	III	51.615
Capiz	15.34	III	52.680
Catanduanes	15.30	IV	52.652
Cavite	18.11	I	58.950
Cebu	18.22	II	59.153
Cotabato	15.88	IV	53.812
Davao del Norte[c/]			
Davao del Sur[c/]	17.30	II	57.055
Davao Oriental[c/]			
Eastern Samar[d/]	13.47	I	48.343
Ilocos Norte	16.78	III	55.954
Ilocos Sur	16.02	II	54.189
Iloilo	16.79	III	55.906
Isabela	16.36	I	54.931
La Union	16.45	IV	55.201
Laguna	17.50	III	57.492
Leyte	15.64	I	53.277
Marinduque	15.63	IV	53.464
Masbate	15.65	II	53.366
Misamis Oriental	15.84	I	53.763
Mountain Province	14.36	IV	50.382
Nueva Ecija	16.97	IV	56.349
Occidental Mindoro	15.11	III	52.376
Oriental Mindoro	16.11	II	54.447
Pampanga	17.89	II	58.412
Pangasinan	18.37	I	59.507

level of the wife, annual family income, residence, age of the wife, age at first marriage, work status of the wife and number of live births. Given these constraints, we obtain a sub-sample of 1,250 households out of which 932 households have FY < 2.5 and 318 have FY ≥ 2.5 (see Table 4.2). The total sample used in this study is 47% less than the 2,342 sample used by Canlas and Encarnacion (1977). Comparison of the mean values of the variables in Table 4.3 also shows the women in our sample is on the average younger and slightly more educated with a higher level of family income. Finally, Table 4.4 presents the correlation matrix of selected variables.

Initially, we tested the data by estimating a regression specification similar to that used by Encarnacion (1974). Following Canlas and Encarnacion (1977), we assume that $EW^* = 1.5$ and $FY^* = 2.5$[3/]. Using OLS method, we obtain

$$NB = \underset{}{5.2282} + \underset{(0.150)}{0.0164}\ LOC - \underset{(-20.4)}{0.2674}\ AM + \underset{(6.91)}{1.6818}\ CW5 +$$

$$\underset{(14.2)}{3.3937}\ CW6 + \underset{(20.0)}{4.8671}\ CW7 + \underset{(22.4)}{5.9747}\ CW8 + \underset{(20.8)}{6.6023}\ CW9$$

3/ In his study of the 1968 NDS, Encarnacion (1974) estimated the FY^* to be 1.5, which is approximately the annual wage income of a worker earning a daily minimum wage and working 250 days. Allowing for inflation between 1968 and 1973, Canlas and Encarnacion (1977) assumed the threshold to be 2.5.

Province	Level	Type	Male Life Ex at Birt
Rizal	18.57	II	59.934
Romblon	13.73	IV	49.033
Western Samar[d/]	13.47	I	48.343
Sorsogon	15.71	IV	53.497
Sulu	14.19	II	50.163
Tarlac	17.04	III	56.535

Source: These are estimates of Fr. Flieger made available to Joseph Fernandez.

a/ Model: West

b/ Estimate is for the whole province of Agusan in 1965

c/ Estimate is for the province of Davao as known in 1965

d/ Known only as Samar in 1965

e/ Mortality level

f/ Quality of the estimates

I = best
II = good
III = not as good
IV = least good

Table 4.2 Percentage Distribution of Households by Income: 1973 NDS

	Total	Per Cent
All households	1,250	100.00
FY^- households	932	74.56
FY^+ households	318	25.44

Table 4.3 Comparison of Mean Values of Selected Variables: 1973 NDS

Variables	Canlas and Encarnacion's sub-sample[a] (all sample)	Sub-samples in this study		
		All sample	FY^-	FY^+
LEX		55.4	55.4	55.5
EW	2.18	2.09	1.87	2.70
FY	2.43	2.18	1.34	4.66
AM	20.1	20.0	19.8	20.9
CW5	0.11	0.19	0.21	0.13
CW6	0.21	0.27	0.27	0.27
CW7	0.24	0.28	0.26	0.33
CW8	0.23	0.16	0.15	0.20
CW9	0.19	0.06	0.06	0.06
LOC		0.25	0.21	0.37
LPW	0.17	0.16	0.08	0.38
NB	3.71	3.74	3.66	3.99
Observations	2,342	1,250	932	318

[a] Source: Canlas and Encarnacion (1977).

Table 4.4 Correlation Matrix of Selected Variables

	LOC	LEX	AM	CW4	CW5	CW6	CW7	CW8	CW9	EW	FY	LPW	NB
LOC	1.												
LEX	0.1329	1.											
AM	0.1086	0.0002	1.										
CW4	-0.0212	-0.0558	-0.2175.	1.									
CW5	-0.0049	0.0197.	0.2790	-0.1013	1.								
CW6	-0.0317	0.0586	-0.1682	-0.1289	-0.2947	1.							
CW7	0.0333	0.0162	0.0606	-0.1302	-0.2977	-0.3789	1.						
CW8	0.0100	-0.0552	0.3422	-0.0927	-0.2119	-0.2697	-0.2724	1.					
CW9	0.0072	-0.0405	0.3195	-0.0520	-0.1190	-0.1514	-0.1530	-0.1089	1.				
EW	0.3021	0.0645	0.1954	-0.0165	0.0321	-0.0030	-0.0143	0.0124	-0.0262	1.			
FY	0.2116	0.0304	0.1725	-0.0896	-0.0751	-0.0254	0.253	0.1067	0.0345	0.4021	1.		
LPW	0.0546	-0.0828	0.0928	-0.0362	-0.1230	0.0323	-0.0111	0.0786	0.0728	0.1540	0.3104	1.	
NB	-0.0326	-0.0565	-0.1076	-0.2674	-0.3469	-0.0648	0.2338	0.2275	0.1277	-0.1181	0.0376	0.0121	

$$0.2531\ EWN - 0.1189\ EWX - 0.2552\ LPW + 0.1534\ FYN$$
$$(2.03) \qquad (-2.27) \qquad (-1.92) \qquad (2.44)$$

$$0.0057\ FYX$$
$$(0.165)$$

$$\bar{R}^2 = 0.466$$

Basically, the results are similar to those obtained by Encarnacion (1974) and Canlas and Encarnacion (1977). An increase in FY and EW below FY^* and EW^*, respectively, tends to raise NB. This is indicated by the coefficients of EWN and FYN which are both positive and significant at 1 per cent level. On the other hand, a rise in EW above EW^* (EWX) exerts a significant negative effect on NB. In this particular equation, FY above FY^* (FYX) has a negative effect on NB but it is insignificant. These observations suggest that above the threshold the substitution effect might be as large as the income-effect. In brief, the findings conform to the hypothesis that the NB of households with $FY < FY^*$ and $EW < EW^*$ is constrained by the wife's capacity to bear children, while the NB of more educated and higher income families might, in contrast, be demand-determined. Assuming that this interpretation is correct, which need not be so for reasons previously discussed, we group the sample into two, households with $FY < FY^*$ and those with $FY \geq FY^*$. For convenience we label these groups as FY^- and FY^+, respectively. Regression estimates of the effect of

provincial life expectancy at birth (LEX) were then obtained by OLS for each of them as well as the combined sample. The results are presented in Table 4.5. In the combined sample, the coefficient of LEX is significantly positive and the elasticity of NB with respect to LEX at their mean values (η_{bx}) appears to be in the neighborhood of -.5. An examination of the regression estimates for FY^-, however, reveals that it is not significant. In contrast, the effect of LEX among FY^+ families is significantly negative as might be expected. In addition, it is interesting to note that the absolute value of η_{bx} appears to be greater than (but close to) unity. These results, then, seem to confirm Encarnacion's interpretation of the threshold effects of income. This is further supported by the fact that the coefficient of wife's employment status (LPW) is significant for FY^+ but not for FY^-. It is strange, however, that EW does not seem to influence NB among FY^+. Finally, it might also be noted that while EWN among FY^- families is positive as expected, EWX is negative. This can be interpreted to mean that even among families with $FY < 2.5$ there are some wives whose level of fertility is not effectively constrained by their capacity to produce children and these are likely to be women with high educational attainment. One reason for this is that income is underestimated in the 1973 NDS. Another explanation is that theoretically the income threshold (FY^*)

Table 4.5 Estimated NB Equations for FY^-, FY^+ and Combined Sample[1/]

	All sample	FY^-	FY^+
Constant	7.1427	5.8328	10.0979
LEX	-0.0347 (-2.15)	-0.0153 (-0.817	-0.0824 (-2.48)
EWN	0.2956 (2.37)	0.3356 (2.37)	0.2814 (0.999)
EWX	-0.1367 (-2.64)	-0.2174 (-3.03)	-0.0224 (-0.280
FY	0.0499 (1.920	0.1409 (1.879)	-0.0049 (-0.117)
AM	-0.2676 (-20.4)	-0.2566 (-16.8)	-0.2886 (-11.0)
CW5	1.7323 (7.13)	1.7664 (7.06)	1.6247 (1.393)
CW6	3.4511 (14.4)	3.2725 (13.2)	4.1010 (3.54)
CW7	4.9147 (20.2)	4.8810 (19.3)	5.1662 (4.45)
CW8	6.0150 (22.6)	5.8746 (20.6)	6.5342 (5.55)
CW9	6.6394 (20.9)	6.5107 (18.7)	7.0738 (5.75)
LOC	0.0553 (0.501)	0.1503 (1.134)	-0.0803 (-0.395
LPW	-0.2772 (-2.08)	-0.2526 (-1.306)	-0.4642 (-2.29)
$\bar{R}^2$	0.466	0.472	0.454
sample size	1250	932	318

[1/] Numbers in parentheses are t-values.

should, strictly speaking, vary with education as well as the other independent variables as could easily be shown from the model presented in section 1. In general, FY^* should be lower when either the demand shifts downwards or the natural fertility curve shifts upwards. An increase in EW for a given family income brings about precisely these changes. This suggests that, as a result of making FY^* fixed, we might have included some women in the group whose fertility behavior is presumed to be constrained by natural fertility on the basis of family income, when in reality they are not because of their higher level of education.

To test the model further, we examine the fertility effect of LEX in relation to the observed education threshold. Instead of splitting the sample, however, we try the following specification

$$NB = a_o + a_1\,EWN + a_2 EWX + a_3 AM + a_4 FYN + a_5 FYX + \sum_{j=0}^{2} a_{b+j}\,LOC_j + a_9 Z_1\,LEX + a_{10} Z_2\,LEX + \sum_{k=5}^{9} a_{6+k} CW_k$$

On the basis of the preceding discussion, we expect a_9 to be insignificant and a_{10} to be significantly negative. The estimated equation presented in Table 4.6 confirm our expectations, although the elasticity (η_{bx}), when $EW \geq EW^*$, is only -.73. Again, it appears that EWX is insignificant. Before

Table 4.6 Estimated NB Equations: The Effect of Education and Life Expectancy[1/]

Constant	7.6380	4.0634
EWN	.5830(3.03)	.7193 (3.24)
EWX	-.0812 (-1.48)	-.2666 (-4.25)
AM	-.2667 (-20.45)	
FYN	.1528 (2.45)	.1839 (2.55)
FYX	-.0114 (- 0.33)	-.0334 (-.84)
LOC_o	-1.5945 (-0.86)	-1.7394 (-.80)
LOC_1	.1296 (1.04)	.1828 (1.26)
LOC_2	-.9218 (-.47)	-1.3129 (-.60)
Z_1.LEX	-.0074 (-.27)	-.0108 (-.34)
Z_2.LEX	-.0429 (-2.24)	-.0515 (-2.33)
CW_5	1.7370 (7.17)	1.2641 (4.53)
CW_6	3.414 (14.33)	2.5870 (9.53)
CW_7	4.8902 (20.15)	3.6442 (13.42)
CW_8	5.9795 (22.51)	3.9742 (13.92)
CW_9	6.5781 (20.79)	3.9645 (11.84)
$\bar{R}^2$	.47	.29
Sample size:	1250	

[1/] Number in parentheses are t-values.

concluding, however, that education has no negative influence on marital fertility, it should be noted that its effect might have been largely captured by the age at marriage variable (AM).

At this point, we would like to introduce the idea that in analyzing fertility behavior age at marriage might be viewed fruitfully as an endogenous variable, determined, in part, by the interaction between the expected capacity of women to bear children and desired number of births. The hypothesis is that in a situation where excess capacity usually develops and becomes larger as in the case of women with a certain level of income and education, social norms or opinions favoring delayed marriage might have evolved especially in countries where birth control methods are difficult to obtain or are not yet socially approved. Consequently, we conjecture that above EW^* an increase in EW is likely to lead to delayed marriage inasmuch as the number of births to be avoided rises with education as can easily be seen in Fig. 1. On the other hand, an increase in EW below EW^* is not likely to result in delayed marriage since women with this characteristic are expected to encounter a shortfall in supply. On the basis of this hypothesis, we estimate the above equation without the age at marriage variable. We can see from Table 4.6 that the t-value of the coefficient of EWX increases dramatically from

-1.48 to -4.25, while that of EWN remains largely unchanged. In addition, we obtain the following equation,

$$AM = 20.046 - \underset{(-1.25)}{.516}\ EWN + \underset{(7.27)}{.758}\ EWX + \underset{(.93)}{.032}\ Z_1.LEX$$

$$+ \underset{(1.06)}{.037}\ Z_2.LEX + \underset{(3.32)}{1.745}\ CW_5 + \underset{(6.04)}{3.082}\ CW_6 + \underset{(9.17)}{4.672}\ CW_7$$

$$+ \underset{(14.04)}{7.499}\ CW_8 + \underset{(15.56)}{9.777}\ CW_9 \qquad \bar{R}^2 = .36$$

As expected, the effect of EWX on age at marriage is significantly positive, while that of EWN is not. For analogous reasons, we were expecting similar results for LEX. Its coefficients, however, do not seem to be significant. The reason for this might be that the recent provincial structure of mortality rates might be very different from that which prevailed in the past when most of the women in the sample were making marriage decisions. Finally, we note that age at marriage appears to be rising monotonically with the wife's current age. An explanation for this is tha over time nuptiality rates especially among younger cohorts have been falling historically (Smith 1975) and those who di not marry at younger ages are mostly women who want to marry later; hence, the average age at marriage of those who are currently married would be depressed and, therefore, AM and CW_k could appear to be positively correlated.

SUMMARY AND CONCLUSIONS

This paper examined a model of fertility behavior in which some women have excess capacity, while others have excess demand. This idea, which underlies a current explanation for the persistence of high birth rates in many LDCs in spite of drastic reductions in mortality, has not received adequate attention in econometric analyses of fertility behavior. An exception in this regard is Encarnacion's studies. An implication of this model, which has earlier been confirmed empirically in the Philippines, is that the marginal effects of income and education are positive below some critical (or threshold) levels beyond which, however, they tend to be negative. This bit of evidence, unfortunately, is not conclusive in view of the argument that such observed inverted-U shaped relationship could also be generated by a demand model without having to assume excess demand. For this reason, we examined and tested the implications of the model regarding the fertility effect of life expectancy. Our findings conform quite well with the model under consideration. We find that above EW^* and FY^* the effect of life expectancy at birth is significantly negative and the numerical values of the elasticities appear to be close to unity (.72 and 1.15 for $EW \geq EW^*$ and $FY \geq FY^*$, respectively). This result suggests the importance of the insurance

motivation and/or the substitution effect on demand for children that might have been generated by systematic variations in relative costs arising from changes in life expectancy. In contrast, an examination of the fertility behavior of households below the threshold income and education reveals that the influence of life expectancy is not significant, a finding that conforms to the idea that fertility among these families are largely determined by the wife biological capacity. Additionally, we find the fertility effect of labor force participation of the wife to be negati and significant above the threshold income but not below it.

Finally, we also tested the model by examining age at marriage. Our hypothesis is that individuals marry later the larger the expected excess capacity to bear children in order to minimize unwanted births. This relationship might be particularly true in the absence of cheap and effective birth control methods that are socially acceptable. Consequently, we conjecture that, if the model under study is correct, (1) education above EW^* should be positively correlated with age at marriage inasmuch as excess capacity is expected to be larger the more educated the woman is; (2) below EW^*, however, the correlation should be insignificant since women in this situation on the average are likely to wa more births than they could produce. Interestingly, our

empirical results appear to confirm our conjectures. On the whole, therefore, we find the model quite robust as far as the Philippines is concerned.

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