K. B. Pathak and P. K. Murthy

A Fresh Look at the Threshold Hypothesis of Fertility Change in **ESCAP** Region

Introduction

AMONG several theories proposed for explaining change in fertility in relation to socio-economic conditions of population, the threshold hypothesis has been gaining attention in the recent past. According to this hypothesis 'in a developing country where fertility is initially high, improving economic and social conditions is likely to have little, if any, effect on fertility until a certain economic and social level is reached; but once that level is achieved, fertility is likely to enter a decided decline and to continue downward until it is again stabilized on a much lower plane.' (See United Nations, 1963, p. 144). This hypothesis links the process of demographic change with social and economic change.

After analysing a cross-sectional data of 125 countries around 1960, United Nations arrived at the threshold values of 12 social and economic development indicators for a shift in the economic level. As it was not possible to specify exactly the threshold values of each indicator, threshold values were stated in the form of threshold zones.* The minimum values in the low fertility countries was assumed to be the lower limit and the maximum value in the high fertility countries was assumed as the higher limit for the threshold range.

The original threshold hypothesis concerns the **fertility** component **in the**

*The threshold zones were, however, later modified by eliminating **extreme** observations **and renamed** as Reduced Threshold Zones **(RTZ).**

usual theory of demographic transition. It, however, shares with the transition theory the basic assumption that the decline in fertility is interrelated with a decline in mortality and change in social, economic and cultural conditions of the population. Threshold theory, however, fails to formulate a casual chain between fertility and other variables. And its application at the aggregate country level is severely limited because of wide intra-country heterogeneity in cultural and social variables and differential rates of change in the complex of social, cultural, economic and demographic factors within each country.

Another basic problem with the threshold hypothesis is to determine the unique threshold zones for all social, cultural and economic indicators taken together. While there has been a lot of criticism about the threshold hypothesis for its conceptual linkage by Coale (1969), Van DeValle and KnodeI (1967) have found that fertility decline took place in some of the European Countries even without reaching a particular level of economic development. Further, the threshold values might differ under the changing conditions of the societies. For example, China achieved the decline in fertility much faster without the social and economic development indicators crossing the threshold zones.

Some demographers have recently started feeling that separate threshold zones should be worked out for different major cultural regions in order to account for heterogenity in cultural and political systems (See Kirk, 1971; Retherford, 1979). Srikantan (1977) has also given a threshold analysis for 21 social, economic and demographic indicators for different countries. The basic problem that one faces in the use of threshold values is the fixing of the timing for a country of a decline in fertility to be inferred from the fact that some indicators of development have reached the threshold zone while others have not. Which indicator is more crucial for such a decline? How much should it move (or how long should it stand still) over the threshold zone to counteract the lag in the level of other socio-economic indicators?

In the recent past, some demographers have expressed the view that there must be a combined index for socio-economic development, which is applicable to the countries of the world as a group at any time. To our knowledge no attempt has been made to develop a composite threshold zone of all the indicators taken together to gain a better capability for prediction of fertility change in any country on the basis of the knowledge of the single index of the development. However, even the series of "correspondence points" developed by Mc Granahan and colleagues (1972) at the United Nations Research Institute for Social Development (UNRISD) fails to explain the changes in fertility which are taking place in the developing countries, including India. Inspite of the fact that many of the socio-economic indicators, $e0_0$ and IMR have not reached the index level as indicated by correspondence analysis or threshold zone analysis of United Nations, the crude birth rate of India seems to have declined to the level of 35, *circa* 1975.

The present analysis attempts to obtain such a combined index of socio-economic factors on the basis of the available and reliable data about indicators of socio-economic development for 12 countries of the ESCAP region of South East Asia. The threshold zone of the combined index so obtained is tested for its consistency among the countries of East and South East Asia. The weights for calculating the composite index refer to the period *circa* 1970. It may be mentioned that the level of fertility of most of these countries was very little affected by the family planning programme around 1970. The same weights have been used to calculate the index of socio-economic development for 1975 and 1980 also. Further, the threshold zones ascertained around 1970 have been used to check the fertility transition of different countries over time.

Data

Six demographic and socio-economic variables are selected for the present study. The selection of the variables is based on the earlier study by Pathak and Murthy (1981). The set of the six variables, namely life expectancy at birth *(X_1)*, Infant mortality rate (X_2), adult female literacy (Y_3), percentage of females (15-64) economically active *(X_4)*, GNP per capita (T_5) and percentage Urban (X_6), is found to be quite sufficient to determine the effect of demographic and socio-economic variables on fertility. These six variables are also closely interrelated.

For the present study, twelve countries of the ESCAP region are selected. A complete set of reliable data is available for the years 1970, 1975 and 1980 for all these countries. The selection of the countries is based on the demographic and socio-economic characteristics of the countries and iheir introduction of the family planning programmes. Among the twelve countries, all except Japan belong to the group of the less developed countries of the world. The main source of income in most of the countries is agriculture. Urbanisation and industrialisation in these countries are in the initial stages.

Three of these countries had a crude birth rate below 25 circa 1970, six countries had a crude'birth rate between 25 and 40, and *three* countries had a crude birth rate above 40. The non-availability, uncomparability and unreliability of the data for the three years 1970, 1975 and 1980 for the six indicators for some other ESCAP countries, restricted the authors for considering only *twelve* countries of the ESCAP region.

Most of the data are collected from the United Nations Publications. For some countries like Japan. Singapore and Hong Kong, the data are collected from the country sources that were given in the United Nations Publications. Wherever the reliable data are not available, the United Nations extrapolated values and projected values have been used. Tables 1, 2, and 3 of the appendix show the crude birth rate and values of some selected socio-economic indicators of the selected ESCAP countries circa 1970, 1975, 1980 respectively.

Approach

After the threshold hypothesis proposed by the United Nations (1968) failed to specify threshold values more successfully for the less developed countries of the world, many attempts have been made by different demographers (Kirk, 1971; Mari Bhat, 1975, Srikantan 1977) to modify the United 'Nations threshold hypothesis theory. Kirk has suggested the limiting of the threshold theory to most homogeneous cultural regions. By applying the theory to the Latin American region (Kirk, 1971, pp. 138-143) he found some significant correlations between level of crude birth rates and eight selected social and economic indicators. It appears that at least in some cases threshold analysis may have some prcdective value. Man Bhat (1975) proposed a method of modifying the United Nations threshold zones. He has arrived at a set of modified threshold zones by standardizing the RTZ's of all indicators. He tested the modified threshold zones in six countries of Asia where fertility has reached a lower level. But he failed to give a good reason for the failure of the modified threshold zones in his paper. Srikantan (1977) in his study introduced the coefficient of separation of the threshold and he also tested the threshold ranges of the indicators for statistical significance.

In the present paper, to derive a combined Index, it may, however, be safely assumed that the fertility of a region (or a country) will come down depending on the overall development of the region (or a country). Simply developing in respect of any one indicator or two may not be sufficient to cause decline in fertility. Take Iran for example. Its per capita income (Petro-dollars income) is very high, but it is backward in social and other indicators of development and hence its fertility continues to be very high. The fertility level of such a country may not come down further in the absence of the development in the other demographic, socio-economic factors like literacy, urbanisation, female economic activity, reduction in IMR and even distribution of income.

We can represent the overall index of development for a given country by a simple formula:

$$I = \frac{\Sigma W_i \times X_i}{\Sigma W_i} \Big/ 1000$$

where, X_i is the value of the variable "i", and W_i is the weight assigned to the same variable "i". If we divide the sum of the products of the values and their weights by the sum of the weights and divide it by 1000 we will get the index value. Two methods have been adopted to determine these weights, and as such two indices have been obtained. Both the indices are negatively correlated with fertility.

For the first index the zero order correlation coefficient values of the crude birth rate with the six development variables (namely life expectancy at birth, infant

mortality, female adult literacy, percentage of females (15-64) economically active, GNP per capita, percentage urban respectively for the year 1970) are taken as weights. All the variables of social and economic development have been so chosen that their correlations with fertility index are always negative. As such in place of IMR we have taken 1000 - IMR as index of development. Table 4 of the Appendix shows the intercorrelation matrix of the variables with fertility variable CBR for 12 countries of the ESCAP region *circa* 1970.

For the second index, the *eigen* vector corresponding to the largest *eigen* value gives the relative weights to the six indicators of development. The *eigen* vector corresponding to the largest *eigen* value was found by using the iterative procedure, developed by Hotelling (1933) and further discussed by Tatsuoka (1971) after standardising the variables. These weights for calculating the 1st and 2nd indices are given below:

Variable	X_1	X_2	X_3,	X_4	X_5	X_6
Weights for the 1st index	—.87	—.90	—.61	—.08	—.79	-.87
Weights for the 2nd index	1.00	1.00	0.79	0.06	0.87	0.90

Analysis

It is possible to find out empirically what countries are developed, what countries are in the developing stage and what countries are below the developing stage, by considering a range of values for the indices with respect to fertility. In order to find out what countries have crossed the threshold range, what countries are in the threshold range and what countries are below the threshold range, it is necessary to classify the countries *a priori* into three groups. Like Srikantan (1977), the *twelve* countries are classified into three groups as: (1) those countries with a crude birth rate above 40 (pre-fertility-transition countries), (2) those countries with a crude birth rate below 25 (post-fertility-transition countries) and (3) those countries with a crude birth rate between 25 and 40 (countries in the process of fertility transition).

The floor and ceiling values for the crude birth rates are somewhat arbitrary. For instance, the crude birth rate of Pakistan was estimated at about 47.3 in *circa* 1970. Thus, it is included in the group of below transition countries, although it may also qualify for the transition group. Such an element of arbitrariness is unavoidable in any *a priori* classification; however, it is circumvented to some degree by creating the in-between transition group, (Srikantan, 1977). One way of doing away with arbitrariness is to associate development

index with fertility and fix limits by trial and error method (something like correspondance analysis) such that this classification distinguishes the countries very clearly from each other.

The lower and upper limits of threshold zones for the indices are found out by the method followed by the United Nations (1968). The lowest value of the index recorded for countries of low fertility (crude birth rate below 25) and the highest value recorded for countries of high fertility (crude birth rate above 40) are taken -as the threshold zones for the overall index. The threshold zones of the index ascertained for 1970 have been used to check the fertility transition of the *twelve* countries for the periods 1975 and 1980 also. The lowest figure recorded for the 1st index in 1970 for countries of low fertility is .43 for Singapore; the highest figure recorded in the high fertility countries is .24 for Pakistan. The threshold zone is thus defined as .43 to .24 for this 1st Index and five countries are in this threshold range around 1970. In a similar way the threshold range of the 2nd Index is defined as .43 to ,24 and the same five countries are observed in the threshold range in 1970. It is noteworthy that both the indices are giving the same threshold ranges and also similar results. It is also seen that the values for defining the threshold ranges are coming from the same countries.

Table 1 gives the values of the first and second development indices of selected ESCAP countries for the years 1970,1975 and 1980. Countries are arranged in the descending order according to crude birth rate, *circa* 1970. The number of countries in the threshold range determined by both the indices increased from five in 1970 to eight in the year 1975. Three countries namely India, Indonesia and Pakistan which were in the 'pre transition' group of countries in 1970, entered into the 'transition group' of countries by the year 1975. This shows that these countries have progressed socially and economically to a desirable extent by the year 1975. Inspite of low values of developmental indices, the fertility in these countries has declined considerably by the year 1980. It probably indicates that reduction in the crude birth rate in the recent years has been more due to the impact of family planning programmes. The earlier study by Pathak and Murthy (1981) also supports the above view. On the other band, Korea and Malaysia which are found in the 'transition group' of countries in the year 1975, entered the 'post transition group' of countries by the year 1980.

From the above table one can also observe that with the increase in the index value there occurred a reduction in the fertility level. On the other hand where the socio-economic development is slow, the fertility has declined very little. Also for these countries the value of the index is small. For Sri Lanka, the first index of development in the year 1975 is noted to be .28 which remains same in the year 1980. This shows that Sri Lanka has experienced a slow socio-economic development between the years 1975 and 1980. The same is confirmed from the value of the second index in 1975 and 1980 also.

TABLE I—VALUES OF FIRST AND SECOND DEVELOPMENT INDICES OF SELECTED ESCAP COUNTRIES FOR THE YEARS 1970, *1975* AND 1980

Selected ESCAP Countries	*1970*		1975		*1980*	
	1st Index of Develop-ment	*2nd Index of Develop-ment*	*1st Index of Develop-ment*	*2nd Index of Develop-ment*	*1st Index of Develop-ment*	*2nd Index of Develop-ment*
Japan	0,63	0.62	1.42	1.40	1.66	1,63
Hong Kong	0.44	0-44	0,60	0.59	0.85	0.83
Singapore	0.43	0 .43	0.73	0.72	0.89	0.88
Sri Lanka	0.26*	0.26*	0.28*	0.27*	0.28*	0.26*
Korea, Rep. of	0.29*	0.29*	0.41*	0,41*	0.47	0.47
India	0.23	0.23	0.24*	0.24*	*0.25**	0.25*
Malaysia	0.31*	0.30*	0.38*	0.38*	0.45	0.44
Thailand	0.26*	0.26*	0.30*	0,30*	0.33*	0.33*
Philippines	0.27*	0.27*	0.30*	0.30*	0.33*	0.33*
Indonesia	0.22	0.22	0,25*	0.25*	0.28*	0.28*
Nepal	0.21	0.21	0.22	0.22	0.22	0.22
Pakistan	0.24	0.24	0.24*	0.24*	0.26*	0.26*

Indicates those countries 'in the threshold range (or those countries in the developing stage).

Table 2 represents the positions of the selected twelve ESCAP countries with respect to modified threshold zone of MariBhat (1975) in 1970 and 1980 according to five social and economic indicators as well as according to the threshold zone for the overall Index of the present analysis. The modified threshold zone values seem to be more applicable to the transitional stages of the developed countries like Japan, Singapore and Hong Kong rather than those of less developed countries such as India, Indonesia and Pakistan which have recently experienced declines in fertility and increase in their development index. For instance India, Indonesia and Pakistan which were in the 'below threshold zone' group in the year 1970 are observed to be in the same groups in 1980 also according to **Mari** Bhat (1975), where as in our study the above three countries which were observed in the "below threshold zone" in 1970 are observed 'in the threshold zone' group in the year 1980, The latter finding is commensurate with the fact that these countries have experienced a fall in their fertility in the recent past.

TABLE 2—THE POSITIONS OF THE TWELVE SELECTED ESCAP COUNTRIES WITH RESPECT TO THRESHOLD ZONE IN 1970 AND 1980, ACCORDING TO FIVE SOCIAL AND ECONOMIC INDICATORS AS WELL AS OVERALL DEVELOPMENT INDICES

Indicator along with its Threshold Zone	1970			*1980*		
	Countries below threshold zone	*Countries in the threshold zone*	*Countries above the threshold zone*	*Countries below threshold zone*	*Countries in the threshold zone*	*Countries above the threshold zone*
Income per head (US $) (225-388)"	Sri Lanka, India Thailand, Philippines, Nepal, Pakistan, Indonesia	Korea, Malaysia	Japan, Hong Kong, Singapore	Sri Lanka, India, Nepal, Pakistan	Indonesia	Japan, Hong Kong, Korea, Singapore, Malaysia, Thailand, Philippines
Urbanization (per cent) (16.3-23.6)"	Thailand, Nepal	Sri Lanka, India, Indonesia, Pakistan	Japan, Hong Kong, Singapore, Korea, Malaysia, Philippines		India, Thailand, Indonesia, Nepal	Japan, Hong Kong, Singapore, Sri Lanka, Korea, Malaysia, Philippines, Pakistan
Life Expectancy (years) (59.8-63.5)"	India, Thailand, Philippines, Indonesia, Nepal, Pakistan		Japan, Hong Kong, Singapore, Sri Lanka, Korea, Malaysia	India, Indonesia, Nepal, Pakistan	Philippines	Japan, Hong Kong, Singapore, Sri Lanka, Korea, Malaysia, Thailand

Infant Mortality (65.2-46.4)«	India, Thailand, Philippines, Indonesia, Nepal, Pakistan	Sri Lanka, Korea, Malaysia	Japan, Hong Kong, Singapore	India, Philippines, Indonesia, Nepal, Pakistan	Thailand	Japan, Hong Kong, Singapore, Korea, Sri Lanka, Malaysia
Female Literacy (64.8-72.4)*	India, Malaysia, Indonesia, Nepal, Pakistan	Hong Kong, Singapore, Sri Lanka, Thailand	Japan, Korea, Philippines	India, Malaysia, Indonesia, Nepal, Pakistan	Singapore, Sri Lanka,	Japan, Hong Kong, Korea, Thailand, Philippines
Overall Index of Development (.43-.24)b	India, Indonesia, Nepal, Pakistan	Sri Lanka, Korea, Malaysia, Thailand, Philippines	Japan, Hong Kong, Singapore	Nepal	Sri Lanka, India, Thailand, Philippines, Indonesia, Pakistan	Japan, Hong Kong, Singapore, Korea, Malaysia

"Ranges given by Mari Bhat (1975) for individual indicators.
"Range given by authors in the present article for the overall indices of development.

An attempt was also made to find put the first index value by considering the correlation coefficient values between the fertility variable TFR and the *six'* socio-economic variables as weights. But almost the same weights, as obtained with CBR, were obtained with TFR also.

It is also interesting to note that almost the same weights are obtained whether 1970, 1975 or 1980 is taken as the base year for analysis. We are thus on a firmer ground to assume the robustness of the weights used in calculating the overall index of development. The zero order correlation coefficients of both the first and the second index with crude birth rate *circa* 1975 come out to be same i.e.,—.86 if we exclude Japan.

Concluding Remarks

With the threshold ranges of the overall indices of development, it is now possible to categorise the various countries in different states of transition. The prediction can now be unambiguous and more certain. Attempts in future may however be made to obtain some standard weights to obtain the overall indices and to modify the threshold ranges if possible. In order that data requirement be kept to the minimum, we have to confine our attention to some salient indicators of health, social and economic development. The policy makers may find useful to ascertain as to which indicator could be pushed through to raise the overall index of development so as to effect decline in the fertility.

Unfortunately the time series data on various aspects of development for any country are not generally available. Otherwise the threshold zones for individual countries can also be prepared to avoid effects of political ideology on fertility in different countries. The results of this study may however be treated only tentative and preliminary. A more extensive study needs to be done.

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APPENDIX

TABLE 1—CRUDE BIRTH RATE AND VALUES OF SOME SELECTED SOCIO-ECONOMIC INDICATORS OF THE ESCAP COUNTRIES, CIRCA, 1970

	CBR	X_1	X_2	X_3	*X4*	X5	X6
Japan	19.3	71.9	986.9	98.1	58.4	1,920	72.2
Hong Kong	20.0	71.1	980.7	64.1	46.0	970	93.4
Singapore	22.1	67.3	979.5	60.1	31.1	920	86.3
Sri Lanka	29.4	65.6	952.5	70.9	32.5	110	22.4
Korea, Rep. of	30.0	64.8	946.2	87.0	37.1	234	41.1
India	36.9	47.8	869.0	19.4	43.6	110	19.9
Malaysia	37.0	65.1	951.6	42.4	38.5	380	27.8
Thailand	39.4	59.2	910.0	70.3	*76.6*	200	13.3
Philippines	39.7	57.0	895.0	91.0	43.0	210	31.8
Indonesia •	43.2	46.3	857.5	44.6	35,6	80	17.5
Nepal	43.7	42.5	835.1	3.9	61,2	80	4.0
Pakistan	47.3	43.6	871.8	13.4	9.5	170	24.3

SOURCES: United Nations. *Demographic Trends and Policies in ESCAP Countries 1978* (Bangkok: 1979).
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TABLE 2—CRUDE BIRTH RATE AND SELECTED SOCIO-ECONOMIC INDICATORS OF SELECTED ESCAP COUNTRIES, CIRCA 1975

	CBR	Xl	X_t	X_3	*X4*	Y_5	X_6
Japan	15.6	75.3	990.7	98.8*	51.0	6.036	75.9
Hong Kong	17.7	72.9	986.5	68.4	49.2	1.760	95.3
Singapore	16.6	70.2	987.6	66.3	40.2	2,450	90.2
Sri Lanka	27.5	68.0	954.9	69.6*	55.0	190	25.3
Korea, Rep. of	24.0	67.4	961.3	84.0*	39.4	864	48.4
India	35.2	49.5	877.0	23.2*	42.4	140	20.5
Malaysia	33.0	66.3	956.7	52.2*	38.1	760	30.2
Thailand	35.6	60.8	948.0	75.1.	74.7	350	16.5
Philippines	37.2	59.9	906.3	92.0	41.8	380	33.8
Indonesia	37.0	48.0	872.4	50.6*	46.7	220	19.0
Nepal	46.8	44.3	848.0	5.0	60.6	no	5.0
Pakistan	47.1	51.1	885.5	11.7*	10.0	160	26.9

Figures with asterisk mark are interpolated values.

SOURCE; United Nations, *Demographic Trends and Policies in ESCAP countries 1978* (Bangkok: 1979).

TABLE 3—CRUDE BIRTH RATE AND SELECTED SOCIO-ECONOMIC INDICATORS OF SELECTED ESCAP COUNTRIES, CIRCA 1980

	CBR	X_1	*Xs*	*X**	X_4	X_5	X6
Japan	14.0	75.4	992.0	99.5	53.0	7,280	77
Hong Kong	16.5	74.0	987.0	75.0	49.2	3,040	96
Singapore	16.5	70.9	988.0	67.6	42.0	3.290	92
Sri Lanka	25.3	69.0	957.6	68.0	55.0	190	26
Korea, Rep. of	21.3	68.9	963.0	81.0	40.0	1,160	56
India	33.3	54.0	875.0	28.0	42.0	180	21.8
Malaysia	31.9	68.1	959.0	62.0	38.0	1,090	32
Thailand	31.0	63.7	945.0	80.0	74.0	490	17
Philippines	35.0	61.3	911.0	87.0	41.0	510	35
Indonesia	32.2	49.7	880.0	58.0	47.3	360	20
Nepal	42,6	46.7	861.0	3.0	60.0	120	5
Pakistan	42.4	52.6	894.0	9.0	10.0	230	29

SOURCES : United Nations, *Demographic Trends and Policies in ESCAP countries 1978* (Bangkok: 1979).

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TABLE 4-CORRELATION MATRIX OF SELECTED SOCIO-ECONOMIC VARIABLES, CRUDE BIRTH-RATE OF SELECTED ESCAP COUNTRIES, CIRCA 1970

	1	2	3	4	5	6	7
1. Life expectancy at birth							
2. 1000—Infant mortality	0.99						
3. Percentage of literate adult female population	0.75	0.68					
4. Percentage of females 15-64 *in* labour force	0.04	—0,08	0.20				
5. GNP per capita	0.68	0.71	0.49	0.13			
6. Percentage urban	0.75	0.80	0.47	-0.13	0.80		
7. Crude birth rate	-0.87	-0.90	-0.61	-0.08	-0.79	-0.87	